THE CORNELL ENGINEER

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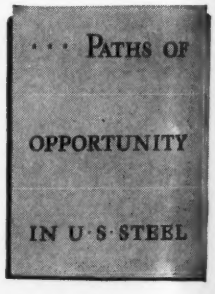

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CONTENTS

Trends in Air Transport Design 7
William Littlewood, M.E. '20
A New Scale in City Planning 10
Professor Thomas W. Mackesey
Engineering Enrollments 12
Dean S. C. Hollister
Sailing . . . A Science for Pleasure 13
John H. Gay, EP '51
Efficiency in Plant Layout 16
Jack Corbin, EE '50
Book Reviews 18
Alumni News 19
President's Message 20
Engineering Societies 21
Techni-Briefs 22
Prominent Engineers 24
Editor's Column 25
Student-Faculty Lounge 26
Frederick S. Turk, AEME '49
Engineer's Day Returns to Cornell 27
Out of Phase 28
Herbert F. Spirer, EP '51
Stress and Strain 52

Cover: Cornell Corinthian Yacht Club Narrasketuck plows the blue waters of Lake Cayuga off the Yacht Club shore.

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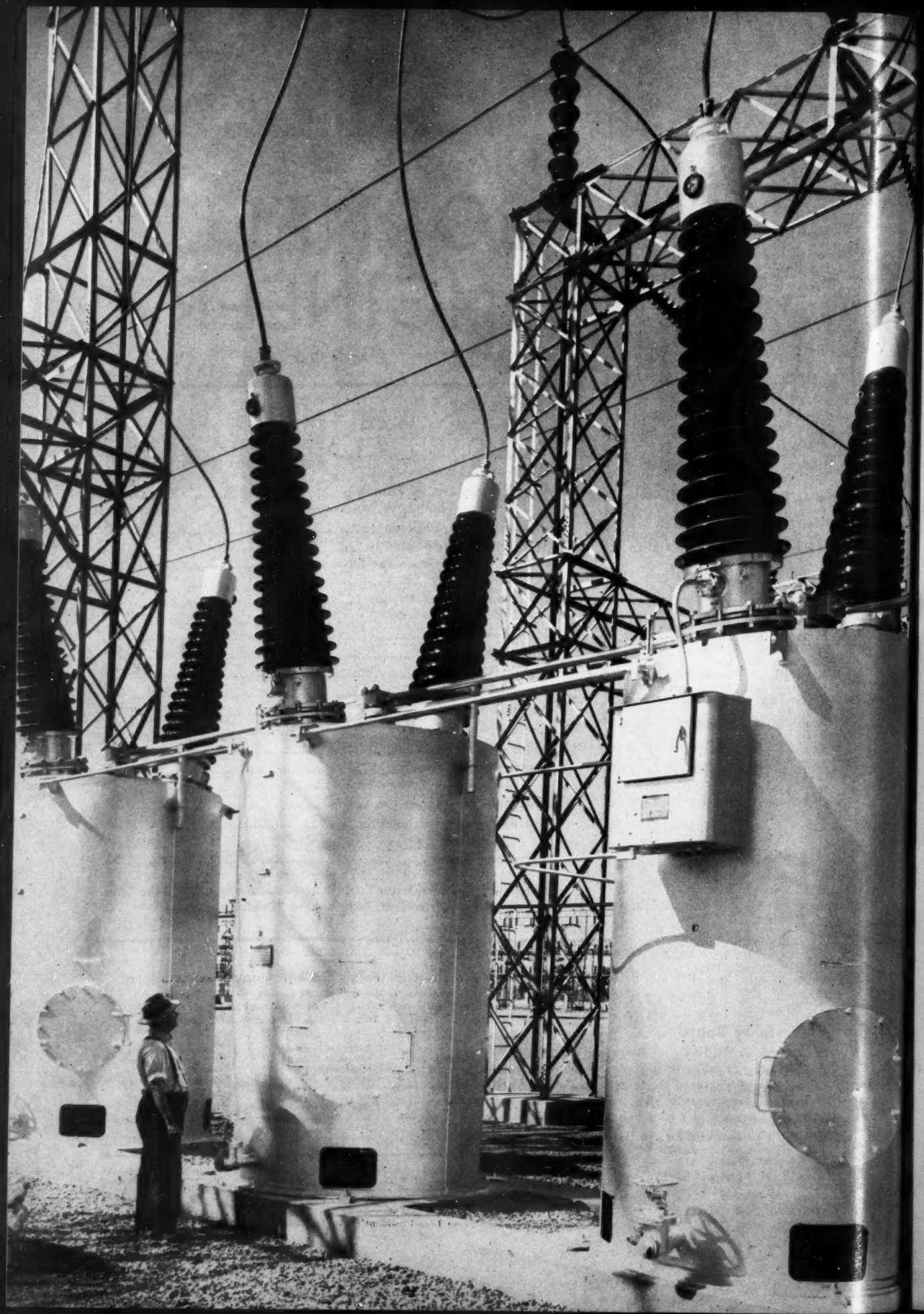

Developments In Air Transportation

By WILLIAM LITTLEWOOD, M.E. '20

Photographs courtesy American Airlines System

AN Engineer who undertakes to predict five years ahead in the rapidly changing field of air transport design may well be considered rash; one who is willing to guess ten years in advance is certainly foolhardy; and one who might be willing to prophesy for a longer period is surely slightly "tetched." But perhaps we can discuss some current problems in the field, the successful solution of which will help determine the long range trend of development. One way to study where we are going is to look back and examine the direction from which we have come, and the nature and rate of our progress to date. We are interested in analyzing how fast we may fly, how far we may travel, how large our airplanes will be, what they will carry—of people and goods, and, of course, with what safety, dependability, comfort and economy we may enjoy them.

Practical aviation is just past forty-five years of age. Commercial air transportation is about half that old. The all metal, multi-engine, streamlined air transport airplane of reasonably modern type is even younger than that . . . actually, only about fifteen years of age. In order to give us at least that fifteen year perspective, we may refer to Table I which lists a few basic characteristics of the principal modern type American transport airplanes, starting with the Douglas DC-2 of 1934 and ending with the just certificated Boeing 377. This table appears to show certain significant trends in performance, weight, power and capacity.

Factors Discussed

Let us first look at speed. If we go all the way back to the beginning of practical aviation and remember that the first flights were made at approximately thirty miles per hour, and then note that the latest of these transports, forty-five years later, can cruise at approximately 310 miles per hour, we recognize an average speed increase of six and one-half miles per hour per year. This is not widely different from the rate of increase evidenced during the last fifteen years, derived from the figure of Table I, which shows an increase of 120 miles per hour in that period, equal to about 8 miles per hour per year. These have been the reasonably constant coefficients of speed increase with time for com-

A 230 KV, 3-cycle circuit breaker capable of interrupting 2½ million kva.

—*Courtesy Westinghouse*

THE AUTHOR

Mr. Littlewood is Vice-President, Engineering of American Airlines System. As a student at Cornell University he assisted on the staffs of the Physics, Mechanics and Machine Design Departments, and was awarded the Sibley Prize, symbol of the highest scholastic rating in Engineering for two consecutive years. He was elected at the beginning of his Junior year to membership in Tau Beta Pi, national engineering honorary society.

He joined the Engineering Department of American Airways, predecessor company of American Airlines, in 1930; was made Chief Engineer in 1933 and Vice President in charge of Engineering in 1937. In 1945 he also became Vice President, Engineering for American Overseas Airlines. In 1935, Mr. Littlewood was awarded the Wright Brothers medal, presented annually by the Society of Automotive Engineers for an "outstanding contribution to aviation." He is a member of the National Advisory Committee for Aeronautics; Chairman of the Committee on Operating Problems — NACA; Fellow and past Vice President of the Institute of the Aeronautical Sciences; Member and past Vice President of the Society of Automotive Engineers; Director of the Cornell Aeronautical Laboratory; Executive Vice President of the Cornell Society of Engineers; Vice President of the Cornell Alumni Association; Member of the Cornell Club of New York; Member of the Engineering Committee, A.T.A.

William Littlewood

BASIC CHARACTERISTICS OF AMERICAN TRANSPORT AIRPLANES

TABLE I

Airplane	*T.O. Gross Wt.*	*Landing Wt.*	*Powerplants No.*	*Type*	*Total Power*	*No. Psgrs. Std.-Day*	*Cruise Speed at Cruise Altitude*	*Pressurization*
Douglas DC-2	18,560	18,560	2	SGR-1820F	1,700	14	180 mph 8,000′	No
Douglas DC-3	25,200	24,400	2	R-1820G	2,400	21-28	190 mph 10,000′	No
Douglas DC-4	73,000	63,500	4	R-2000	5,800	44-60	200 mph 12,000′	No
Martin 202	39,900	38,000	2	R-2800W	4,800	36	260 mph 12,000′	No
Convair 240	40,500	38.571	2	R-2800W	4,800	40	280 mph 15,000′	Yes (to 20,000′)
Douglas DC-6	93,200	75,000	4	R-2800D	8,400	52-58	305 mph 20,000′	Yes (to 25,000′)
Lockheed Constellation 749	105,000	84,500	4	R-3350	10,000	50-60	305 mph 20,000′	Yes (to 25,000′)
Boeing B-377	142,500	121,700	4	R-4360	14,000	60	320 mph 25,000′	Yes (to 30,000′)

mercial aviation and, interestingly enough, a long range plot from the beginning shows about twice the average number, or about 14 miles per hour per year, as a straight line increase in the top speeds of military aviation performance. We can certainly expect of the transport future, increases of at least the average commercial rate of the past and if, on that very conservative basis, we look ten years ahead, we can easily see 400 miles per hour cruising speeds. If we look twenty-five years ahead, we will expect at last 500 miles per hour performances, and fifty years from now, we will certainly be cruising better than 700 miles per hour.

This is surely a most conservative approach to our problem, for we are and have been, for the past several years, busily engaged in surmounting what used to be looked upon as an almost impossible barrier to performance advance—the speed of sound. The true problem has not been just one of breaking a mysterious barrier at *Mach I*—the speed of sound—which at sea level is approximately 750 miles per hour, and coming out on the high side to smooth and easy sailing. That has been done untold thousands of times with high velocity projectiles. The real difficulty has been to devise a controllable flying machine which would perform satisfactorily through the ascending speed scale from zero velocity at the start of its flight, through the unstable region of transonic speeds from approximately .8 to 1.2 times the speed of sound, where the airplane and its controls are subjected to variable and uncertain aerodynamic phenomena, and providing thereafter controllable flight with adequate power and thrust in the stable supersonic range, and then successfully reversing the entire process, as must obviouly be accomplished with a man-operated and man-carrying flying machine for commercial purposes.

American type plane for normal runs. The relatively small amount of dead weight makes it economically sound for today's traffic.

The problems of smooth and easily controlled passage through the transonic speed range are still to be satisfactorily solved. It is a matter of common knowledge that the speed of sound has been substantially exceeded in man-operated military flying machines, but the cost of such performance is illustrated by the fact that with a relatively small airplane, 8,000 pounds of fuel were required for two and one-half minutes of flying at the supersonic speed attained. It is quite evident, even after the engineering problems are solved, that the commercial use of supersonic speeds will be largely a matter of economics. It does not seem likely that commercial aviation will encroach on the truly transonic and supersonic fields for many years to come.

Speeds Correlated with Altitudes

It is interesting to note that one of the usual and natural direct accompaniments of high speed in aviation is high altitude. This, of course, is to reduce the thrust requirements by virtue of the rarer and smoother air at high altitude. Again

referring to Table I, you will note that operating altitudes up to 30,000 feet are now available with the latest airplane. At this height and above, however, the associated problems rapidly increase. Conventional powerplants of the reciprocating type indicate disproportionate supercharging requirements. Propellers become difficult, if not impossible, to design to cover the extremely wide variation of requirements from the zero forward speed at sea level to very high velocities in the rarer air at high altitude. Structural and sealing problems, and the weight requirements for cabin supercharging, become very great. The dangers of explosive decompression are accentuated since, in such event, at altitudes much above 30,000 feet, only a few seconds are allowed for a human being to adjust himself to the rarified atmosphere. Substantial developments are therefore necessary in order to operate commercial aviation much above 30,000 feet, and while we may look forward to a gradual encroachment on these higher altitudes, it will be at a decreasing rate which will act as an additional deterrent to the achievement of the very high speeds which must, for reasonable economy, be associated with very high altitudes. High altitude and its advantages—speed, comfort and economy-wise—are desirable features of long range travel but are obviously impractical for short distances—so we will always have a distance-altitude relationship to consider.

Human Comfort Considered

There is another problem of very high speed performance which concerns the factors of human comfort as well as those of structural strength and weight. The force reaction in vertical gusts is a function of the square of the speed, and while this is compensated to a considerable degree by the natural trend toward higher wing loadings (weight per square foot) for high speed aircraft, this is continually opposed by the problems of the design of suitable high lift devices and more recently, air brakes, to cope with the requirements for limiting speed in descent and operation at the lower altitudes for maneuvering, takeoffs and landings. The natural trend of design for very high speeds is toward extremely clean, sleek lines for all elements including sharp nosed fuselages and nacelles and sharp leading edges, and thin flight surfaces. These desirable characteristics considered with the accompanying high gust loads, result in a design paradox where the necessary strength increase must be achieved with smaller wing and fuselage sections inevitably resulting in very heavy skin and structural members with added weight and serious encroachment on an already decimated space availability. In other words, very high speed is achieved at a very substantial sacrifice of airplane utility. There is no space to store adequate fuel for long range operation. There is limited room for the crew, and there is certainly inadequate space for the passengers and cargo which, after all, are the justifications for commercial aviation. These factors combine to retard the technically possible rate of speed advance and would appear to make more logical the relatively conservative speed numbers mentioned earlier.

Let us now take a look at weight and size. Our Table I of fifteen years of modern air transport development shows an increase in takeoff gross weight from 18,560 pounds for the DC-2 to 142,500 pounds for the Boeing 377. Certain other notable Amercian efforts have been made to produce airplanes of even larger size, such as the Lockheed Constitution, the Douglas C-74, the Consolidated C-99, the Martin Mars and the highly controversial Kaiser-Hughes Flying Boat. It is almost self-evident that if there is a specific ton-mile task to be performed, as with the Berlin airlift, the largest units of satisfactory flying quality, to be operated continuously at 100% load factor, will produce the greatest ton-mile result with a minimum expenditure of manpower and material, and with the greatest simplification of the air traffic prolem. Where, however, we must list among basic factors, capital requirement, schedule and route flexibility, and a normal load factor substantially less than 100%, size as such becomes a secondary attribute, subject to determination by other considerations.

Very practical considerations, also, are the human and cargo load sizes which can be handled expeditiously. If the airplane unit is too large, the practical requirements of space layout and door design make

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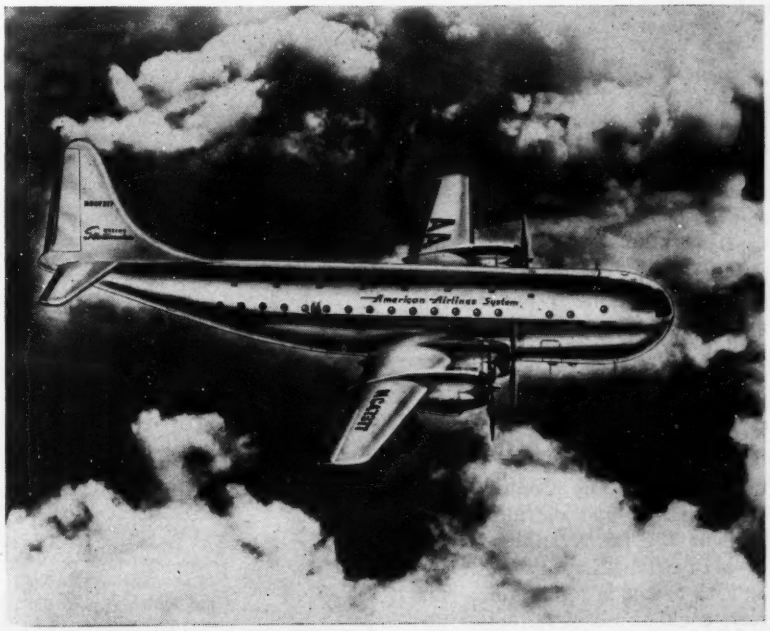


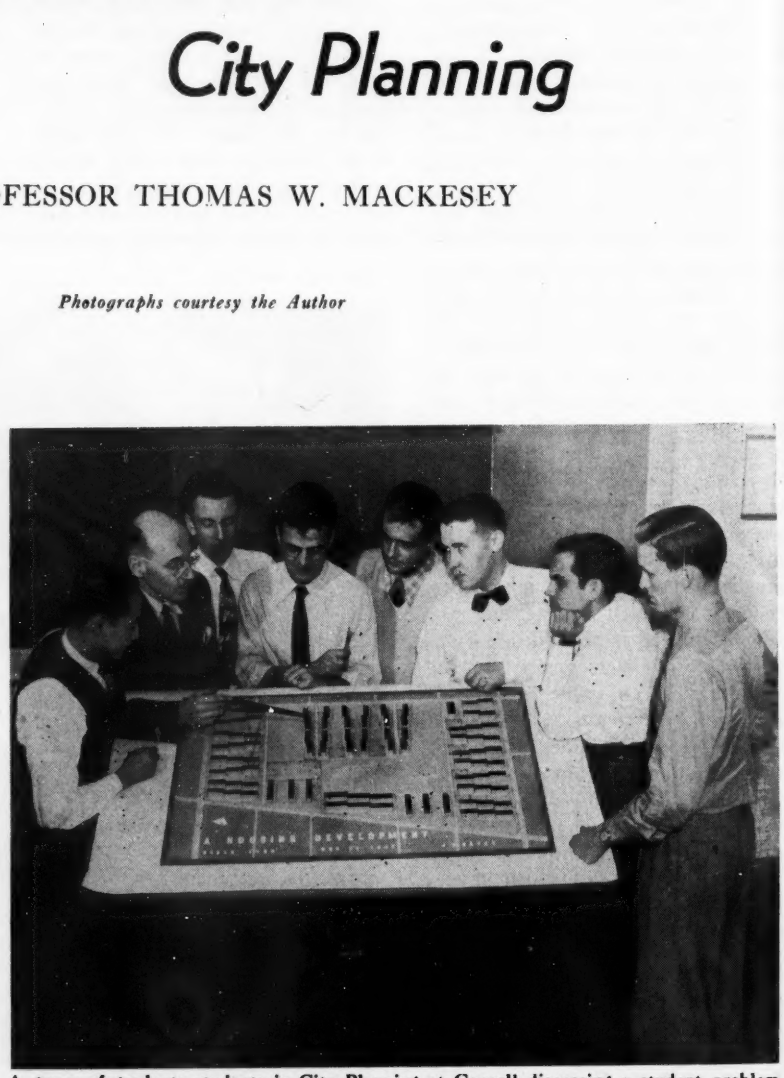
Boeing B-377 Stratoliner. The large capacity of this plane makes it best fit for long runs and air cargo.

A New Scale In City Planning

By PROFESSOR THOMAS W. MACKESEY

Photographs courtesy the Author

THE technological developments of the past two hundred years have left their mark on nearly every aspect of our lives, with the exception of the plans of our cities. Our teaming and bustling cities, of course, present a far different appearance than the cities of the Middle Ages or of the ancient Roman Empire, but, until recently, the basic pattern of dividing the surface of the land into streets and building lots had hardly changed for centuries. The Commissioners who, in 1811, had the foresight to lay out the farms and wilderness of Manhattan Island as far north as 15th Street in a plan for a great city, could think of no better way to divide the land than the ancient rectangular system used by Alexander the Great, in the fourth century B.C., in founding colonial towns on the frontiers of his new empire. The gridiron plan of straight streets intersecting at right angles was, of course, already well established in America when the plan of Manhattan was adopted, and it has since spread all over the country.



A group of graduate students in City Planning at Cornell discussing a student problem for the redevelopment of a blighted area.

The basic virtue of the unrelieved gridiron plan has always been the ease and speed with which it could be laid out on paper and staked out on the ground. It divided building land into blocks, all of the same size, and divided blocks into lots, also all of the same size. Variations of topography did not bother the designers of these mathematical street systems. The Commissioners who laid out Manhattan did not concern themselves in the least with profiles for their streets and avenues. The entire island was treated as if it were as at as flat as the paper on the draftsman's board. Any variation in the level of the land, hill or ravine, was considered, if it was considered at all, only an obstruction that must yield before the logic of geometry. A contemporary writer complained that the City "was resolved to spare nothing that bears the semblance of a rising ground . . . these are men, as has been well observed, who would have cut down the seven hills of Rome, on which are erected her triumphant monuments of beauty and magnificence, and have thrown them into the Tiber or the Pontine Marshes."

City Planning Was Non-existent

The most serious shortcomings of these rigid street patterns is their

bland disregard for what was to go on the land. Perhaps that is an unfair criticism, for certainly those who laid out our early street plans could not be expected to anticipate the eventual use of land in a dynamic urban community. The fact remains, however, that no thought was given to the way the building land was to develop. All of the streets in the gridiron plan are through streets, all are the same width, with minor variations, regardless of whether they served or were intended to serve industrial, commercial or residential properties. All the blocks were the same size and all the lots were the same size. The skyscrapers of midtown Manhattan, each of which houses thousands of workers, are served by streets exactly the same in width as those that serve the industrial districts or the residential areas.

The fact is, of course, that city planning until the twentieth century was street planning pure and simple—simple certainly. The first fumbling attempts to plan and develop areas within the community for specific uses were made about 1900. We have now reached the understanding that planning for the street system and for urban land use are mutually dependent. It is futile to plan for one without the other. We know that an area of single family houses requires an entirely different kind of street pattern than an industrial area.

Aerial view of Stuyvesant Town and Peter Cooper Village which the Metropolitan Life Insurance Company is completing in the Borough of Manhattan. Hundreds of tenements and other old buildings were demolished so that the new plans could be evolved.

Traffic Problems

It is painfully apparent that the internal combustion engine has thrown a load upon existing street systems that they simply cannot handle. The solution is not in more streets. There is plenty of land—even too much—now devoted to traffic movement in the city. About one-third of the developed area of our cities is in streets—and still traffic congestion is one of the most spectacular problems of every city. It is apparent also that the social values of neighborly living tend to become lost in the city—that the congested large city with its sidewalks and alleys for playgrounds and its roaring and fume-spewing traffic is not a good place for bringing up children. The ancient type of street plan that has served faithfully for so many centuries has become obsolete.

For some years the most congested sections of our large cities have been losing population. The movement to the suburbs has been one of the most pronounced social phenomena of the past half century. Families have deserted the cities, as they have become able to do so, to find safer, healthier and pleasanter surroundings in which to live and to bring up children. The worker submits to the wasteful grind of commuting because only by so doing can he secure a rational

(*Continued on page 42*)

THE AUTHOR

Thomas W. MacKesey

Thomas W. Mackesey is Professor of Regional Planning in the College of Architecture at Cornell and Assistant Dean of that College. He was graduated from the Massachusetts Institute of Technology in 1932 with the degree Bachelor of Architecture and was later granted the degree Master of City Planning at M.I.T.

Now in his tenth year at Cornell, he has served as consultant in City Planning to many cities and towns in New York and other states. Graduate students who have studied City Planning under him at Cornell now hold responsible positions with planning agencies throughout the country.

Trend of Engineering Enrollments

By S. C. HOLLISTER

Dean, College of Engineering, Cornell University

Many statements have appeared in the public press in recent months indicating general alarm that the present rate of training of engineers is rapidly leading to a large surplus in the profession. It is of no small concern to the profession, and in fact to the nation, to scrutinize this view carefully, since any severe maladjustment between engineering training and employment rates in either direction might have serious effects.

The following analysis is intended to give a different perspective to the matter by presenting a long-range study of the facts involved and establishing this, rather than short-time fluctuations, as the basis for projection.

The problem actually involves the time-honored factors of supply and demand, but since most of the discussion referred to has been based on the apparent high rate of production of engineering graduates at the present time, it may be well to review the "supply" aspect separately and determine just what our current rate of engineering training is, and what trend it shows.

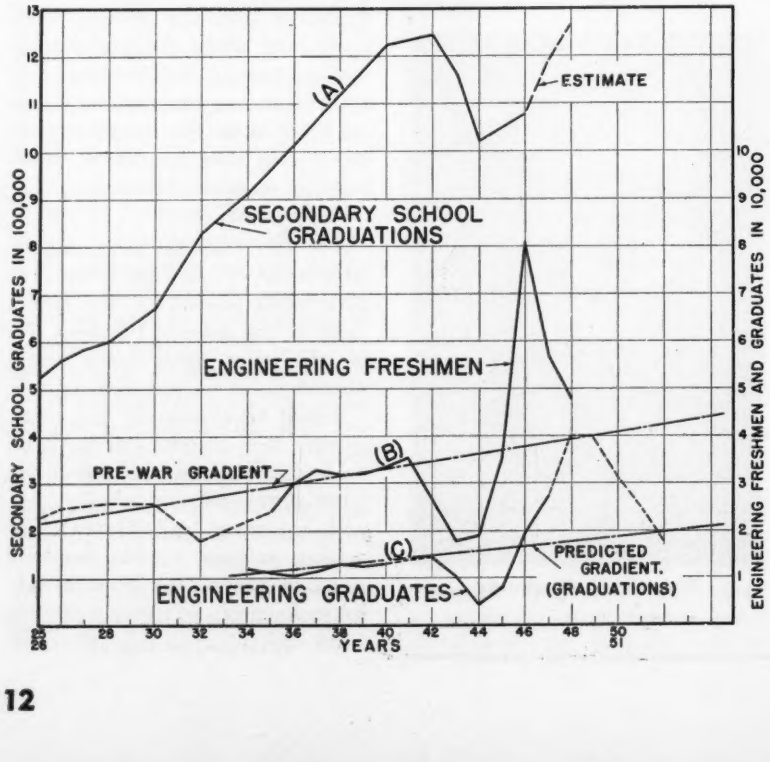
The accompanying chart presents three related curves. Data for Curve (B) are taken from annual statistics on engineering enrollments in the United States and Canada reported in the *Journal of Engineering Education*: total engineering freshman enrollments for each year since 1925 are shown. Below this, in Curve (C), are shown the total engineering graduations in corresponding years. In the war years only civilian totals are plotted. The depression years of the early 1930's, and the war years, show as the major disturbing influences on an otherwise fairly steady curve.

In 1946 we come to the post-war influx of veterans and others whose education had been delayed by the war, bringing about a sudden peak enrollment of 80,000 freshman engineers. Within a year, however, this wave had subsided so that in 1947, freshman admissions were down to about 57,000, and this year they declined to 47,000. If we draw the gradient for this curve, representing the normal pre-war development of engineering education (and thus reflecting the normal pre-war development of the profession) we find that the 1948-49 freshman enrollment is only 7,000 above the pre-war gradient. It will probably meet this gradient, and perhaps dip slightly below it, within the next year or two.

The curve for engineering graduations (C) follows a similar form reflecting a fairly consistent attrition rate from freshman entrance to graduation over the span of years shown. From this and the freshman enrollment curves, it is possible to predict the number of graduations for the next several years, and thus we can expect that by the end of the academic year 1952-53 the up-surge of post-war graduations will have receded to the normal pre-war gradient. In order to estimate the probable trend thereafter we may look at the past influence of Curve (A), which represents total secondary school graduations, on freshman engineering enrollments and subsequent graduations. The steady upward slope of high school graduations through 1940 resulted in the two pre-war gradients for engineering college statistics shown. Thereafter,

(*Concluded on page* 38)

Graph showing engineering enrollments and graduations and the number of graduates from secondary schools.



Sailing . . . .

A Science For Pleasure

By JOHN H. GAY, EP '51

TO primitive man, the water was an unknown menace with monsters waiting under every wave to devour the reckless seafarer who ventured beyond the sight of land. Thus all early aquatic travel was limited to crossing rivers, lakes, etc., that stood in the voyager's path. Logs, dugouts and rafts provided the modus navigandi and for all of these the wind was an extreme hindrance. Breeze-stirred waves and white caps broke over the shallow craft and often washed the occupants and their cargo overboard. Moreover poling or rowing in the face of a spanking good breeze was (and still is, for that matter) no cinch.

An early genius, however, saw a way to put this force of nature to work by making it impart some of its drive to a sail. This sail was probably made of animal hides and, being as crude as it was, would allow the craft to go only before the wind or on a broad reach. It required the efforts of several early civilizations to take and refine this idea and make it their stock-in-trade for conquering the neighboring waters. The Phoenicians were the first great masters of the aquatic art. Long before the Christian era they had great ships at their command and were plying their trade and extending their empire far up and down the Mediterranean, even venturing forth beyond the Straits of Gibraltar. The Polynesians established their civilization in the trackless desert of the South Pacific, performing amazing pieces of navigation between the tiny and

—Courtesy John Snedeker

A Cornell Corinthian Yacht Club boat on a close beat in the inlet.

distant oases of land. The Vikings built their fierce, Teutonic craft and soon subdued the uncompromising North Atlantic with the force of their Volkerwanderung.

Galleons to Clippers

In more modern times appeared the galleons of Columbus' day, the frigates and cutters of the eighteenth century, and finally that great achievement of the boat-builders' art—the clipper ship. The great clippers that brought the whole world within their range were a joy to behold. All the consummate skill and care of their creators went into their making and even today the beauty and grace of their lines are an example to designers.

The form of the sail appears to have had somewhat less attention paid it during this period of the evolution of sailing craft, changing but little during the centuries of creative effort which culminated in the great traders of the 1850's. The early barques of the Mediterranean had one large sail securely mounted to a mast and crosspieces and was but little capable of running onto the wind. The clippers on the other hand had an amazing complexity and spread of canvas that was designed to catch and use every possible stir of air, but they still employed essentially the same fundamental sail design—a four-sided figure, usually near the rectangular—no thought being given to the possibility that this was perhaps not the cut designed for optimum performance.

At the turn of the century, however, a revolution in sail-making loomed large. Designers of early racing yachts at first acceded without question to the old theories and equipped their craft (here, for simplicity, the sloop-rigged craft) with the traditional gaff-rigged mainsail, topsail, and three over-lapping foresails. Then as it became evident to serious students of yacht racing that the vessel was equipped with redundant sail area at some points, tending to reduce the draw of each individual sail, and that at other equally vital points there were skips between sails which allowed wind to cut through the very center of the sail area, the idea presented itself of consolidating the main and topsails into one sail and

the three foresails into another. The new mainsail had to present as much sail area but lack the disadvantages; thus was introduced the original triangular Marconi sail. The successor of the foresails, called the jib, proved practical on smaller boats; however, the practice of having two jibs, one higher than the other, continued with the larger craft.

Introduction of Science

All this was conjecture, however, without the weight of empirical test and scientific development behind it. This latter constitutes the next and most recent stage in the refinement of the sail and involves for the first time a discussion of the actual aerodynamic effects of a sail in the wind and what conclusions may perforce be drawn. The remainder of this article will be devoted to just such a discussion and will be based in the main on the results of the theoretical and experimental work of Dr. Manfred Curry—a renowned German scientist and small-boat enthusiast.

Before proceeding, however, it would be advisable here to define a few technical terms which will be used. (Fig. 1) Considerations will be confined to a sloop-rigged craft—that is a boat with a single mast built to carry two sails, a jib and a mainsail. The mainsail may be one of two standard designs—the triangular Marconi sail or the four-cornered gaff sail, so named for the spar running aft from the mast and constituting its top side. Its mate along the lower edge is known as the boom. The jib is a loose-footed triangular sail set ahead of the mast. The leading edge of a sail is known as the luff, the lower forward corner the foot, and the after edge the leech. A boat sailing at about forty-five degrees off the wind direction is said to be tacking or sailing on the wind; a course at right angles to the wind is called a reach; and, lastly sailing with the wind astern is known as running with the wind or before the wind (Fig. 2).

The author sailed this Boothbay Harbor One-Design in two summer's racing seasons.
—Courtesy Roy Holland

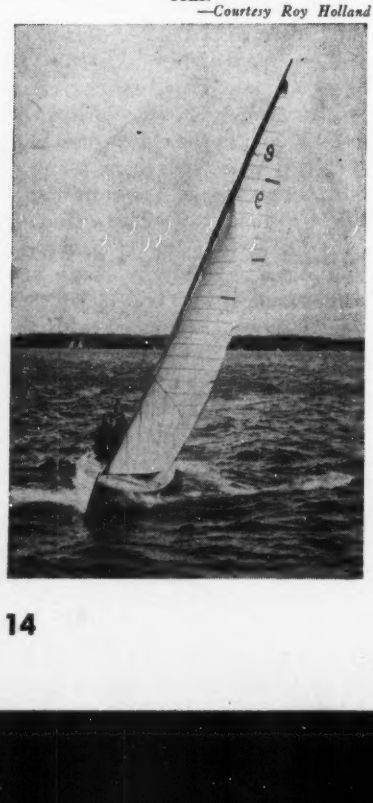
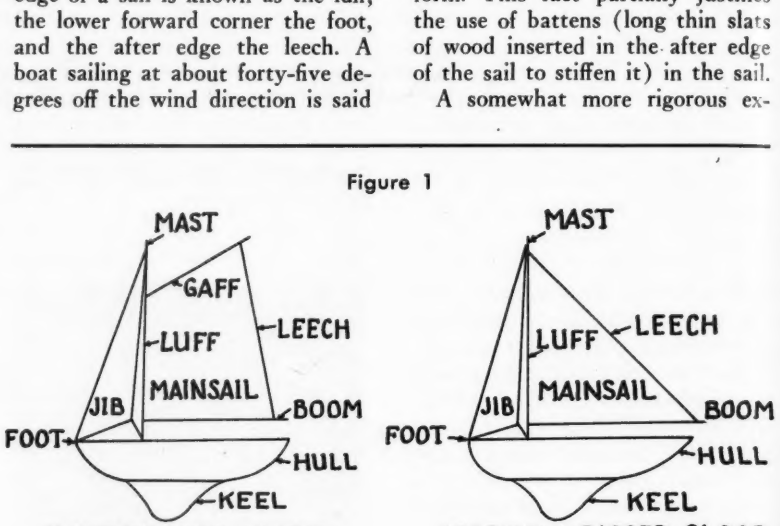


Figure 1



Lessons from Kites

Experiments with a kite will show this to advantage. A kite tightly stretched across the framing will gain little altitude, and this due mostly to the fact that the wind normally blows at an angle of four degrees upwards from the horizontal. The factor of lift enters to only a small degree in this case. A looser kite on the other hand will belly out and develop a considerable vertical component of force. An arching of about 1:7 (the ratio of the height of the arc to the chord) is most favorable to developing lift in a kite and experiments have shown that this is also the optimum arch for most sails. Most modern racing craft, incidentally, allow their sails to belly to about a 1:30 arch, entirely too small for the maximum draw. Thus at least one reform of standard practice would seem to be required in accordance with these tests. The kite experiments show one more fact to advantage. A kite which is constructed with a rather pronounced arch through the use of a curved framing will do better than the kite which allows a loose belly, however near the optimum size, to form. This fact partially justifies the use of battens (long thin slats of wood inserted in the after edge of the sail to stiffen it) in the sail.

A somewhat more rigorous explanation of the phenomena involved in the beneficial action of the arched sail involves an application of some of the fundamental principles of fluid dynamics. According to Bernoulli's Theorem, the sum of the pressure and one-half the product of the density and the square of the velocity at any point along a streamline equals a constant. (Fig. 2) Now the theory propounded by Lancaster asserts that the flow around such an airfoil may be represented by an ideal streamline flow to which is added a circulatory flow. The latter is considered to aid the former above the positively-arched surface and to oppose it at the negatively-arched (as in the case of the sail) or plane surface. An examination shows that, with the superposition of circulation upon streamline flow, the pressure on the side of zero or negative arch exceeds the pressure on the side of positive arch, resulting in a net lift which moves the foil upward. In the case of a sail there are other complications arising but the salient points are essentially the same. One main difference lies in the fact that large eddies are

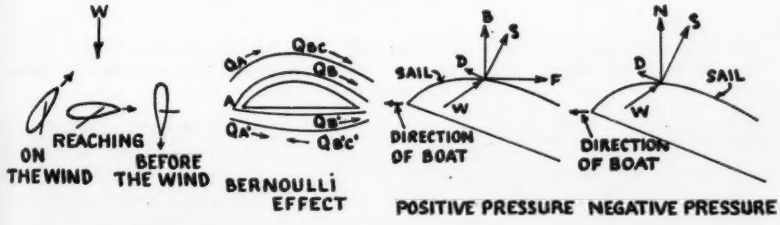
produced in the pocket of negative arch on the windward side of the sail. These eddies will, if the sail is set properly, actually contribute impetus to the craft since they curl inward and strike the sail without undue loss of energy.

The forward drive of the sailboat is developed as a direct result of this lift on the sail. (Fig. 2). The ideal situation described above must again be altered in cognizance of the fact that the wind strikes the sail at an angle from below as shown in the accompanying diagram. This direct pressure of the wind may be resolved into two components—one perpendicular to the sail and the other parallel to it. The parallel component of pressure slips off aft with no other effect than a small frictional drag in that direction. The perpendicular component, however, is directly involved in driving the craft. It may again be broken up into two components, one of which is at right angles to the direction of motion (this is counteracted by the action of the keel or centerboard — stabilizing fins extending below the main body of the hull) and the other of which is in the direction of motion. The Bernoulli effect described in the preceding paragraph adds to a greater or lesser degree to the direct pressure effect.

—Courtesy John Snedaker

#2125 has outmaneuvered #1428 on this windward beat of a Star Class competition.

Figure 2



Dr. Curry's Experiments

Just to what degree this Bernoulli effect is beneficial is the subject of another series of experiments. Dr. Curry has tested and compared the pressures produced by the direct action of the wind on the windward side of the sail (the so-called positive pressure) and the circulation pressure (negative pressure) by means of a gauge inserted in small holes at various points along the sail. These tests were made under all possible conditions; namely, on the wind, on a reach, and before the wind, with or without jib, and with the gaff and Marconi mainsail.

When sailing on the wind, experiments confirm the fact that the negative pressure is responsible for a much greater measure of the total drive than is the positive pressure. When on a reach, the negative pressure again exerts the greater influence but the difference is less pronounced. In the third fundamental situation, that of sailing before the wind, the positive driving pressure, as might be expected, is alone responsible for moving the craft since any negative pressure that might be produced around one side of the sail is counteracted from the other side, and thus all such energy is lost in wasteful eddies. It has been shown that a sail under such conditions operates almost as well with several small holes in it as without them. Negative pressure operates on a run, however, when the boat under consideration is blanketing the leading boat. This produces a draw on the sail and actually helps the man astern pull ahead faster while stealing his opponent's wind.

Marconi vs. Gaff

There is little difference between the Marconi and gaff sails in the matter of maximum drive developed under a given set of conditions. The Marconi sail, however, will develop this maximum drive at a closer angle to the wind than will the gaff rig. This points to the obvious advantage that the boat equipped with a Marconi mainsail may maintain a consistently higher point than its rival. The optimum angle to the wind for the former is about twenty degrees while that for the latter is more than thirty-five degrees. Thus the gaff-rigged boat must trim closer at all times in order to take advantage of this difference. This factor does, however, give the gaff-rigger the edge on a reach since on this point the wind must strike the sail at a greater angle. Were the Marconi-rigged craft to attempt to equalize this difference on the reach by slacking off the mainsheets, the advantage gained by reaching the angle of maximum negative pressure would be more than negated by the loss of positive driving pres-

(*Concluded on page* 40)

FOR GOOD
INDUSTRIAL OPERATION

Efficiency in Plant Layout

By JACK COBIN, EE '50

THE most important single factor in achieving low-cost high-speed production is efficient plant layout. In this age, where a single slowdown on an assembly line means hundreds of lost man-hours of production, constant flow is essential. The vast amount of expensive machinery, designed to do away with handicraft operations, must be so placed on the factory floor that its use will alleviate bottlenecks in the production line rather than increase backtracking and rerouting.

Good plant layout achieves lower costs and high production because: (1) definite work channels are established, (2) shortest traveling distances are planned in advance, (3) the amount of materials handling is reduced, (4) the over-all time and amount of work-in-process are minimized, (5) inventories of raw materials in storerooms and warehouses are reduced, (6) labor and machinery are most efficiently utilized, and (7) floor areas are used to full advantage.

Poor Layout is Inefficient

Too often low and inefficient production can be blamed on poor layout. Taking into consideration that floor space is fixed by building limitations and that desirable changes cannot be made because of this, too many concerns refuse to consider that an improvement is possible if they would only take the time to carefully study the existing situation. Common sense is very often all that is needed to improve a distressing situation.

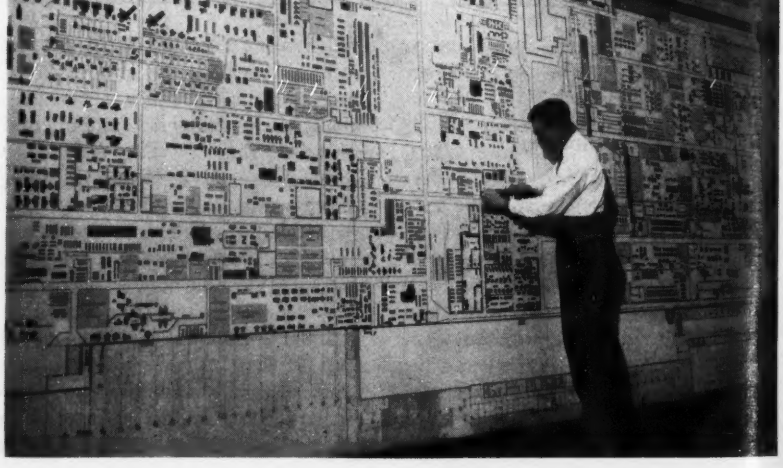
To begin with, we have a factory of such and such a floor dimension by so many feet high. In this factory exists, at any one instant, a fixed quantity of machinery and equipment over which all work must pass on its way to the shipping and mailing rooms. It is up to us to see that production is maintained at a high level and that costs are kept to a minimum. It is only natural to assume that we would want the best possible arrangement of our fixed quantities, namely machines and equipment, so that the work would flow as smoothly as possible. With efficient flow, deliveries would be met at scheduled times and costs would be low. Delays would only mean increased costs and unmet schedules.

Outline of Procedure

In planning a layout, certain steps fall into a natural sequence. It would be best to begin by listing the variety and quantity of finished parts and sub-assemblies which must be produced over a given period of time. This would serve as a goal which must be attained. Next list the materials and parts going into the products to ascertain which would be more economical to make and which would be cheaper to purchase from other concerns. A tabulation of all operations necessary to make the parts and to assemble them as finished products would follow. From the operations to be performed, a sequence must be determined and process flow charts mapped to cover all manufacturing and assembling processes. If additional production equipment or plant facilities are needed, this must be taken into account. A check of plant and machine capacity on manufactured parts as well as sub-assembly and assembly capacity throughout the

Production planning board, used in coordinating and locating the various phases of production operations on the factory floor. It is used successfully to rearrange operations for optimum production.

—Courtesy Westinghouse



plant must be made. Calculations as to time intervals between successive operations and estimates of work backlogs which may develop must be made so that storage space at the machines can be provided. If any operation is particularly hazardous, noisy, or otherwise objectionable, the possibility of isolating such operations in special sections must be investigated. Space requirements for storage areas, aisles, elevator or stairway approaches, storerooms, tool cribs, and offices must be checked for adequacy.

The Model Layout

With the above information gathered and carefully tabulated, it is time to develop the layout of departments and the arrangement of machines and equipment. It is preferable to use the templet method or to use small scale models to facilitate the accuracy, flexibility and speed in bringing the plans for the flow of work to a successful conclusion. With the layout completed, again check with all interested departments to see that the final arrangements are most satisfactory to all concerned.

Two types of layouts are generally employed. One deals with the flow type of production where continuous operations are performed over and over again. The other deals with a type of production that is forever changing, devoted for the most part to special operations which make up special orders. The flow or straight-line method of production is called the *product* layout, while the functional or departmental method of production is often called the *process* layout.

On a mass production basis, the straight-line layout is far more efficient. But to be efficient, certain conditions must exist to make product layout feasible. First of all, the product must be standard. The operations performed must be continuous and repetitious. Some interchangeability of parts among products is demanded. Sufficient volume to keep the production line busy is essential. A good labor balance must be maintained so that an equivalent amount of work is performed at each work station. Inspection of parts or products must be held to a minimum. Finally, there must be a well-organized plan of production control planning, scheduling, and dispatching.

Adherents to straight-line production are automobile plants, iron and steel foundries, rolling mills, canneries, tire plants, cement plants, chemical plants, and bakeries.

In all cases, there is needed a logical work sequence which is provided only by a product layout. Straight-line production does not necessarily have to be confined to a one-story building. Very often multi-storied buildings provide splendid opportunities for gravity flow systems of straight-line production.

—Courtesy General Electric Co.

A typical inspection and test floor. Such methods of assembly line testing facilitate the checking of possible production line errors.

High Production

One industry which did not achieve high production figures until the straight-line method of production had been adopted was the aviation industry. Prior to the war, it was "making" airplanes, but was not "manufacturing" planes.

Before 1940, the Wright Aeronautical Corporation had used a departmental layout for manufacturing aircraft engines. That is, all engines of one general type were grouped together. But when the war demanded thousands of single-type engines, Wright made a complete change. It meant the design and installation of many special-purpose machine tools, the placing of electro-plating and heat-treating equipment directly in the production line, and the increased use of large roller conveyors.

The process layout, in turn, lends itself to plants which rely on producing equipment and parts which are not standard to any large extent. Here machines must be grouped by departments, the milling machines together, the planers in another section of the plant.

Under this plan, locomotive, railroad cars, steamships, special instruments, special machinery, custom made furniture, and a wide variety of non-standard products are made. Production lines of manufacture would be impossible for these products because the runs would be too short to repay their setting up, operating, and then changing such lines to meet a new set of conditions. The best that can be done is to facilitate the direct line movement to and from departments and to avoid backtracking and crisscrossing at all possible points.

In comparing the product layout or straight-line method with the departmental or process layout, each

exhibits certain advantages. The straight-line method allows the flow of work over definite and direct routes; it almost invariably insures less materials handling, closer coordination of production operations, less total production time, less work-in-process, less floor space occupied per unit of product, less inspection, and a simplicity of production control with fewer records, less accounting and lower clerical costs. The departmental layout assumes a lower investment in, and less duplication of, equipment, less machine idleness, more flexibility in getting the work done should breakdowns occur, and more efficient supervision.

—Courtesy General Electric Co.

This efficient conveyor belt system cuts down the handling of materials to a minimum.

Straight-line production is becoming more effective every day. The problem of materials handling had always been one to slow up the flow of parts and sub-assemblies moving down the production line. But now ingenious conveyor systems of all kinds, elevators, transfer mechanisms, pushbutton or interconnection hookups for remote control, and photocell applications for regulation or stopping of systems are widely applied to meet the materials handling problem. Since hand labor is the costliest method of handling materials where production is high, mechanical and electrical devices offer solutions to many vexing problems. Overhead traveling cranes, monorail systems, and mobile equipment such as locomotive cranes are extensively used, both in straight-line and departmental layouts. In addition, lift trucks and fork trucks of the battery or gasoline driven type are almost universally employed, very often operating over regular routes and on fixed schedules.

The Ohio Crankshaft Company recently installed a new roller conveyor to expedite production. Where formerly floor trucks were used to convey the sections of the shaft down the production line, causing cluttered aisles, bunched material, and even misplacement of parts, the new conveyor parallels the machining lines on both sides of an aisle, feeding parts from detail lines into semi-finished stores and out again to assembly.

Conservation of Space

The Bell Aircraft Corporation is another to have heeded the lessons of good plant layout. Whereas individual gas cylinders were employed at each welder's station in the welding department, a piping system was installed to carry oxygen, acetylene and hydrogen directly to the individual benches from a separate, fireproof building. This new arrangement conserves both floor space and manpower and introduces several additional safety factors. Where individual welders had control of gas pressures before, one man now controls the flow of gas into the plant and at comparatively low pressures.

Combination layout, a combining of straight-line methods with departmental routing, offers solutions to manufacturers wanting to obtain the advantages of both systems. However, even where occasional changes in equipment may become necessary, the trend toward straight-line procedure should continue if studies indicate that savings can be made in time and cost of production. For product layout alone has been the answer to eliminating departmental bottlenecks, reducing handling and transfer of parts, facilitating production control, and making possible the employment of large numbers of unskilled men and women as single-operation workers.

Book Reviews

TECHNICAL DESCRIPTIVE GEOMETRY *by B. Leighton Wellman, McGraw-Hill Book Co., Inc.* 508 *pages.*

The author of a new text on descriptive geometry faces the problem of presenting the fundamentals of the subject in a new way, or else he has "just another textbook." The basic concepts of the material are pretty rigidly determined for a college course in descriptive geometry, but the approach, arrangement, and presentation to the student are matters of individual choice and ingenuity.

Professor Wellman has written his book with the idea of teaching the student to reason his way to the logical solution of a particular problem without having to be able to visualize or imagine the various steps. His first chapter overlaps much of the theoretical material on multi-views given in elementary drawing courses without making it appear divorced from descriptive geometry, and the articles on auxiliary views serve the purpose the author proposes of permitting the student to draw the views before he can visualize them. This approach permits and encourages the student to use these methods to assimilate the traditional descriptive geometry facts presented in the subsequent chapters.

The illustrations, of which there are many, are well chosen and are beautifully drawn. The problems for assignment (Professor Wellman assures us there are 1568) are grouped in the last chapter, as many modern texts do for convenience. Most of the problems involving measurement of angles or distances are supplied with the correct answer.

This text is undoubtedly an easy one from which to teach, as there are numerous practical suggestions to the instructor if he wishes to avail himself of them. There are seventeen pages of geometrical constructions in the Appendix, some of which are not ordinarily presented in such a grouping.

Professor H. T. Jenkins
Civil Engineering Dept.

Alumni News

John S. Fisher, E.E. '28, was recently elected president and director of the General Metals Powder Co., 130 Elinor Avenue, Akron, O. He has been with the company since 1929 and in 1932 developed and produced the first commercial metal friction material which is the company's product.

Louis L. Bentley M.E. '29. has been named plant manager of the Armstrong Cork Co. closure plant in Lancaster, Pennsylvania. He has been with Armstrong since 1929 and was promoted to superintendent in 1945. During the war years Mr. Bentley was superintendent of munitions at the same plant.

James P. Stewart, M.E. '28, is vice-president and director of De-Laval Steam Turbine Co., Trenton 2, New Jersey. Mr. Stewart lives at 909 North Pennsylvania Ave., Morrisville, Pennsylvania.

George A. Porter

George A. Porter, M.E. '25, is now serving as chief engineer of the power plants of the Detroit Edison Co., of Detroit, Michigan. Mr. Porter joined the company on graduation and has been with them ever since.

Thomas Borland, M.E. '35, petroleum engineer with Standard Oil and Gas Co., has been promoted to division engineer for the company's drilling and producing operations in Texas and Louisiana Gulf coast, with headquarters in Houston. A daughter, their first child, was born June 1. The Borlands live at 1564 Castle Boulevard, Houston, Texas.

Henry A. Pfisterer, Arch. '29, Associate Professor of Architectural Engineering at Yale University, is co-author, with Harold D. Hauf, of the third edition of "Design of Steel Buildings," published in January by John Wiley & Sons. Mr. Pfisterer also taught structural design at Cornell University from 1930 to 1933.

E. H. Krieg, M.E. '22, has been appointed consulting engineer in the Boston office of the Stone & Webster Corporation. For the last several years Mr. Krieg has been Chief Design Engineer of American Gas and Electric Corporation, in New York. Since his graduation from Cornell, Mr. Krieg has been continuously engaged in the design, maintenance and betterment of steam power stations and has originated many advanced practices in this field. He was employed by Sanderson and Porter from 1922 to 1925, by Electric Bond and Share Company from 1925 to 1933, and has been with American Gas and Electric Corporation since that date. During that time, he was responsible for the mechanical design of high pressure power installations totaling approximately 2,000,000 kw. in capacity, including several units now under construction; designed for operation at 2000 psi and 1050°F with reheat at 1000°F. Mr. Krieg is a Fellow, ASME; a Member, AIEE; and has served for a number of years as a member of the Prime Movers Committee of EEI.

Edward B. Dennis, C.E. '25, has been named to the position of general sales manager of the Kimble Glass Division of Owens-Illinois Glass Co. Mr. Dennis has been with the Kimble Glass Co.

Edward B. Dennis

since 1933 and at the time of its merger as a division of Owens-Illinois was serving as container division sales manager.

Arthur J. Clark, Jr., A.E.M.E. '43, senior stress analyst with Curtiss-Wright Propeller Division in Caldwell, N. J., has received the M.M.E. at Polytechnic Institute of Brooklyn.

Reid Earnhardt, M.E. '45 received the M.M.E. at Carnegie Institute of Technology last spring. He is now with E. I. du Pont de Nemours & Company in Wilmington, Delaware.

William R. Rogers, M.E. '48, is employed by the Carborundum Company Refractories Division as a sales development engineer in Perth Amboy, N. J.

Carl P. Irwin, C.E. '49, is a pneumatic tool salesman for Ingersoll-Rand, New York, Phillipsburg and New Jersey. He will be in Athens, Pennsylvania, for a month and then will be transferred to a branch office for further training.

Cornell Society of Engineers

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Creed W. Fulton, M.E. '09

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

Sitting down in comfortable chair, after a leisurely breakfast last Sunday, I opened the Alumni News, with the usual expectancy. Come page No. 3, I kenw spring must be here, although snow still lingered in spots, for here was the spring itinerary of the "Cornell Men's Glee Club." And, believe it or not, five of the seven scheduled concerts are in cities all within a radius of 125 miles from Philadelphia; but no Philadelphia.

How come? I do not know, but I'm wondering if the title of the show may be significant—"Daze of '49."

Well, there is compensation in the fact that I can hear the boys four times, and return home at a respectable hour each night.

Our Glee Club, and Cornell music, hold top place in my affections, as I imagine they do with many others.

'Way back, in June 1905, to be exact, I visited Ithaca, for the first time, to attend to some entrance details. Three things stand out vividly in my memory of that weekend,—the beauty of the campus, Davy Hoy, and the Cornell Glee Club—led by an old Washington, D.C., Cornellian and Engineer, Eddie Holmes.

Cornell has many outstanding attributes, but one of the finest is our Cornell music. Other colleges have some beautiful songs, but where will you find any one group that excels Cornell's "Alma Mater", "Alumni Song", "Cornell", "Crew Song", "Evening Song", "In the Red and White of Cornell", "Spirit of Wisdom", "Give My Regards to Davy", "The Big Red Team", "Cornell Victorious", "March on Cornell", "1875 Cornell Cheer", and numerous others, less well known, but outstanding.

Few Cornell events are more pleasing or satisfying than a good musical club concert. From the opening strains of "Alma Mater" to the closing "Evening Song", you can enjoy two hours of beautiful songs, and instrumental music, rendered with a spirit and style that are unexcelled in college circles.

Cornell music is a great good will ambassador. Wherever it is heard it transmits, as perhaps no other single medium does, the real spirit of Cornell. It appeals to all types and ages. To try and pick Cornell's outstanding song seems futile. So many are so good.

However, our "Crew Song", to my mind, typifies unusually well the dynamic spirit of Cornell. Born in an era of victory, it radiates the spirit of its day. Where can you excel its words and music?

"Onward like the swallow going,
Roused is every nerve and sense;
Oh, the wild delight of knowing,
'Tis our power that does the rowing.
Oh, the joy of life intense!
Rest was made for feebler folk.
Onward, make her cut the water,
Onward, make her cut the water,
And for fame of Alma Mater,
Stroke! Stroke! Stroke!

There is the pioneer spirit of Cornell set to ageless words and music. And that is just one of our many great songs, which when rendered in true Cornell fashion form a mighty chorus of unalloyed delight.

Therever we are, today or tomorrow, let's join with the voices of our Glee Club to "Lift the Chorus, speed it onward, loud her praises tell."

CREED FULTON

Engineering Honorary Societies

American Society Of Mechanical Engineers

Officers elected between terms were Walter S. Crone, chairman; George A. Goetz, vice chairman; William Kingston, secretary; and George D. Russell, program chairman. At a meeting February 10, the group heard Mr. P. T. Elliott, Assistant Superintendent of Engineering at Eastman Kodak, speak on "Opportunities in Machine Design," explaining the training and work of a design engineer. On February 17, Mr. Harold B. Vogt of Corning Glass Works gave a talk on "New Developments in Glass." Materials testing and processing was the subject of a meeting featuring Mr. Francis Tatnall of Baldwin-Southwark on March 1. These talks are part of a regular series which will be continued throughout the spring.

Cornell Society of Engineering Physics

The Cornell Society of Engineering Physics in a joint meeting with the Undergraduate Physics Society March 14 heard Dr. Hans Bethe of the Department of Nuclear Studies talk on the fundamental particles of modern physics. In an earlier meeting of the CSEP, Mr. E. T. Cranch of the Mechanics Department described some of the typical engineering physics problems he worked on while at the Bell Telephone Laboratories. Projects for the remainder of the spring term are in the planning stages and will include further talks on subjects of technical interest and a society picnic.

American Institute Of Electrical Engineers

With the aid of slides, Professor J. G. Tarboux of the School of Electrical Engineering spoke February 18 to the student chapter of AIEE on the Tennessee Valley Authority. Professor Tarboux is a native Tennesseean who has worked with the T.V.A.

Atmos

The following new members were elected to Atmos at a recent meeting:

Honorary:
Prof. E. D. Watson
Prof. C. I. Millard

Active:
Robert Allan
J. Perry Barger
Merrill Benson
James Brandt
Ralph Coryell
John Craig
George Fitzgerald
Thomas Gardiner
George Goetz
Walter Jensen
Donald Read
Edward Smith
Walter Way

American Society Of Civil Engineers

At a joint meeting of the senior section and the student chapter of ASCE February 22, Col. Harland D. Woods discussed "The Genessee River Dam." A business meeting of the student chapter was held at the same time.

Tau Beta Pi

Tau Beta Pi has introduced a tutoring service under the chairmanship of George Kosc, ME. Any engineering student desiring aid is invited to make use of this free service by contacting his advisor and obtaining a list of volunteer tutors. Although no charge as such will be made, contributions toward the student lounge in Sibley will be accepted.

At a recent meeting, Daniel Emerson, EE, was appointed chairman of a committee to complete plans for a booth at the annual Spring Day carnival.

American Institute of Chemical Engineers

On February 18 the student chapter of AIChE heard Dr. R. W. Lawrence of Hercules Powder Co. discuss "Commercial Explosives."

Eta Kappa Nu

Several projects were planned by Eta Kappa Nu at a meeting held February 15. The group plans to hold this spring a number of discussions of controversial, non-technical topics of world interest, and will schedule talks on these subjects by professors in the School of Electrical Engineering. In addition, the society is sending questionnaires to all electrical engineering students for a survey of fall term courses.

Techni-Briefs

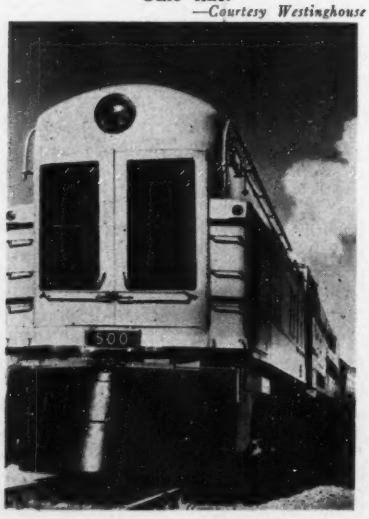
Sanitary Thermometer

For accurate measurement of temperatures under sanitary conditions, a must in food preparation, the Marshalltown Manufacturing Company of Marshalltown, Iowa, has developed a compact and durable bi-metal dial thermometer. A variety of temperature ranges from —40°F to 500°F may be measured. The bulb is made of austenitic chromium-nickel stainless steel and will not contaminate foodstuffs. The bi-metallic element is a laminated strip having high-expansion nickel-manganese steel on one side and an invar type alloy on the other. The material of the thermometer is rolled and formed and then assembled without soldering.

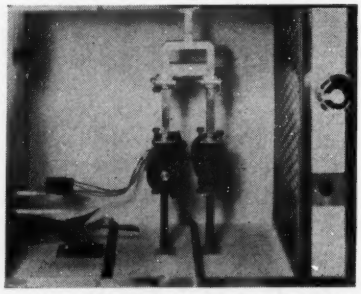
Turbines for More Power

New developments of considerable interest in locomotive drive have recently been appearing on the scene. Already in use on the Chesapeake and Ohio lines are several steam-turbine electrics (see cut) which are giving very satisfactory high-speed service. In addition, a gas-turbine powered locomotive is in the developmental stage. A power plant of this type will provide power equivalent to a diesel engine while cutting down the body length by about one-half. Locomotives of this type are expected to be in service by early next year.

A steam turbine, electric-drive locomotive in service on the Chesapeake and Ohio line.
—Courtesy Westinghouse



Measurement By Microwaves



—Courtesy National Bureau of Standards
This refractometer measures the change with temperature in dielectric constant of a gas.

Rubber Coated Glass

A new silicone rubber-coated glass cloth which will withstand operating temperatures as high as 520°F has been developed by the General Electric Chemical Department. Particularly designed for use as gaskets in radial motors and other aircraft engines, the new material, which is available in both sheet form and fabricated parts, possesses excellent tensile and tear strength and may be applied in many types of electrical and mechanical equipment where superior physical properties are required. It is also commanding considerable attention as an ironing surface by laundries, curtains in bread baking ovens, and, in tape form, as high temperature cable insulation. The fact that it will not adhere to metals or other materials at high temperatures is an important feature of the material.

Cornellian Develops Plastic

A new plastic, transparent, and useful at high temperatures, is now in limited commercial production. It is made up of fluorine and chlorine to the extent of four-fifths of its weight, and is related to the family of organic compounds called fluorocarbons, which reached practical development during the war. The chemical name is trifluoro-chloro-ethylene. Produced by M. W. Kellog Co., of Jersey City, New Jersey, it was developed by Dr. William T. Miller, professor of chemistry at Cornell.

It is extremely resistant to chemical action, even to concentrated sulfuric, hydrochloric, and hydrofluoric acids. It is strong and hard, although not brittle. Its temperature range of usefulness is from —320F. to 390F.

Because of these properties, it is likely to be used in instruments, airplane parts, railroad signals, electrical insulators, and in other places where a weather-resistant plastic is needed. Other uses may include low temperature electrical insulation, because it will not short-circuit its current even in humid conditions, because of its non-wetable properties.

Another interesting property is that it can be treated or tempered very much as if it were steel, and so it may be treated for use at specified temperatures for maximum efficiency.

The chemical inertness is due to the fact that, instead of having hydrogen in the molecule, it has chlorine and fluorine, which form much stronger bonds, and thus prevent the molecule from being broken up.

A storage tank for methyl chloride at GE's new silicone plant.
—Courtesy General Electric

502

PROMINENT

Kent

Wallace K. Clarke, ME

College has become an old story with Kent Clarke. Entering Buffalo State Teacher's College in 1936 he, excluding four years spent in the Navy, has been attending college ever since. He even spent part of his Navy hitch on a college campus as instructor in diesel engines at Cornell. During that time he became enthused over mechanical engineering and liked Cornell so much that he decided to enter the Sibley School of Mechanical Engineering as soon as he could. He was discharged in the spring of 1945 and entered Cornell the fall of the same year.

Kent was born and received all his schooling in Buffalo. While in high school he was a member of the varsity baseball, tennis and soccer teams (the baseball team won all of a 23-game schedule in his senior year) and was salutatorian of his class. Upon graduation from Buffalo State Teacher's College he received a Bachelor of Industrial Arts degree and taught industrial arts for a year. He entered the Navy in 1941 and was married the following year. Besides his sixteen months at Cornell he saw active duty in the South Pacific as executive commander of a PCE (Patrol Craft Escort) and took part in the landings on Borneo and the invasion of the Philippines.

By the time Kent entered Cornell, he had had a good deal of teaching experience and thus began instructing mechanical drawing his first year. At first it was difficult since he had to teach students that were his classmates in other courses. At the same time he was able to compile an enviable scholastic record as his membership to Tau Beta Pi and Pi Tau Sigma indicates. He is now president of Tau Bete and was vice-president of Pi Tau Sigma last term. His hobbies are his family—he has two children—and his studies. When he can find time he also likes to get out and play some golf as well as watch basketball and baseball games. During the summer months he has kept himself busy by doing carpentry work around Ithaca.

Kent graduates in June and plans to get into the field of design and development of reciprocating engines. Whatever field he enters his many and diversified abilities are sure to carry him to the top. The ENGINEER wishes him the best.

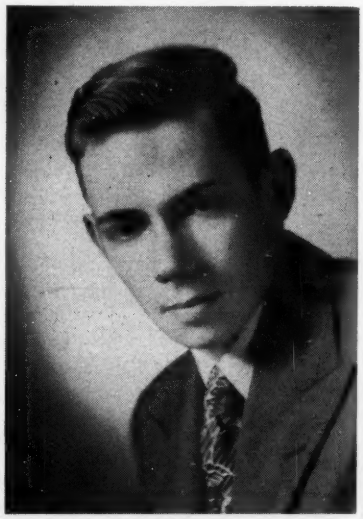
Kenneth M. Gellhaus, EE

Graduating with honors from Baltimore Polytechnic Institute in June, 1945, Ken was offered reportorial work with the Baltimore *News-Post,* but Cornell's call was sufficiently strong to bring him to Ithaca as a sophomore in July of the same year.

Ken's first year at Cornell was a busy one. He was active on the Willard Straight summer committee and became a "compet" on the CORNELL ENGINEER, being elected to the editorial board in October, 1945. Having barely gotten used to his surroundings here, Ken received his "greeting" and was drafted into the Army at the completion of his sophomore year.

After taking basic in Mississippi, and going to "tech" school in Texas, Ken was assigned to the Air Transport Command, Pacific Division, and stationed at Fairfield Suisun Army Air Base, near San Francisco, as a classification and assignment specialist. In March, 1947, he received his discharge and returned to Cornell for the 1947 summer session.

Ken's interest in writing has manifested itself for some time. In high school he was associate editor of the bi-weekly school paper and activities editor of the senior yearbook. Here at Cornell, Ken has been active on the CORNELL ENGINEER, serving as associate editor and managing editor. Many a deadline has been met only because of the long nights he has put in on the fourth floor of Lincoln Hall. Several of Ken's articles have appeared in the ENGINEER from time to time. He has also spoken on, and done some writing for, the "Engineer of the Air" radio programs over station WVBR, and he is a member of the student branch of AIEE.



Ken

The power and administrative option in the school of Electrical Engineering is Ken's biggest problem right now, and if all goes well he graduates this June. After graduation he hopes to put some of his skills to use on technical and re-

ENGINEERS

port writing, or administrative engineering.

We of the staff of the ENGINEER, who have worked with him these last few years know that Ken, with all his experience, perseverance, and geniality, will succeed in whatever field he chooses to enter. We wish him the best of luck.

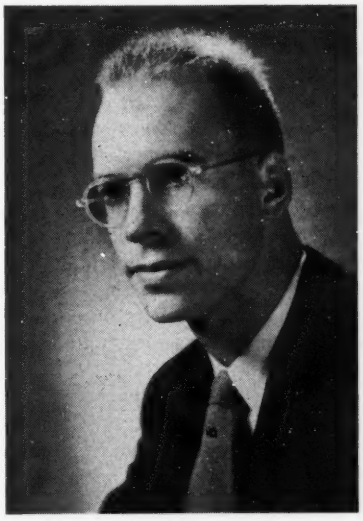
Joseph F. Quinn, ME

Being active in seven activities, and a leader in many of them sounds like a good day's work in itself, but Joe Quinn fits them all in between his classes in the ME school. Consequently, Joe's well-built frame hustling about the campus has become a familiar sight.

A native of Baldwin, Long Island, Joe graduated from Chaminade High School where he excelled in football and track. It being 1943, his next stop was the U.S. Navy. Joe attended Hobart College in Geneva, N. Y. under the V-12 program, but transferred to the Air Corps in February 1944. During his stretch as an air crew trainee he played football with the Iowa Sea Hawks, one of the best-known

(*Concluded on page* 36)

Joe



Ken

Kenneth S. Canfield, ChemE

When Ken Canfield graduated from Newton High School of Newton, Massachusetts, in June, 1942, he decided that his ambition was to row, and having heard that Cayuga Lake is the best place in the East for rowing, he applied to Cornell. After a profitable summer selling Fuller Brushes, Ken entered the School of Chemical Engineering.

In his first year Ken worked out with the freshman crew, but this was interrupted in April, 1943 when the Army called Ken in the ASTP to study civil engineering.

After a year of study, he was sent to Camp Pickett, Virginia, and then to South Carolina for field training, and was finally shipped out with the 380th Engineering Batallion to the Philippines and then to Japan. This pleasant interlude in his career came to an abrupt termination in February, 1946, when the Army promoted Ken to a civilian.

After holding a position as a civil engineer, Ken decided that he'd rather row than construct sewers, and returned to Olin Hall in September, 1946. Ken got right back in the shell and made the junior

(*Continued on page* 36)

The Editor's COLUMN

Answer to the Question

Four or five years ago, when most of the senior engineers first entered Cornell, the outlook for them on graduation appeared bright. The engineering field was undergoing a natural post-war expansion, and job opportunities were numerous and widespread.

In the space of these four years, there have been more engineering graduates than in any other equal period. During this school year, it has become increasingly obvious that the opportunities that were so plentiful when the seniors entered college, now have diminished in number. Fewer companies have sent representatives to the University. With their complement of engineers nearly filled, the industries have gained the dominant position in any interviews which are granted. This year's senior does not have three or four offers from which he may make his choice.

Consequently, there has arisen on the engineering campus a questioning among the undergraduates as to the future of the course of study which they are pursuing. Is engineering a "dead" field; are we members of a stagnant profession?

Elsewhere in this issue is an article in which the Dean attempts to answer our questions. His conclusions, contradictory to some statements that have appeared in the public press, are encouraging. His analysis indicates that by 1953, the surplus of graduates will have disappeared, and the demand again will exceed the supply.

However, before that time arrives, those of us who are about to graduate still have to find our place in the outside world. The picture should not be discouraging; no one can deny that the sign of a healthy vocation is one of competition. Perhaps the present change of events may make some of us take stock of ourselves. A revaluation of our abilities in order to determine our true worth might very well be advantageous to many.

Engineers' Day Returns to Cornell

To those men who were at Cornell in the middle thirties, Engineers' Day meant an occasion to show off the Engineering College by means of demonstrations and exhibits. That occasion has not been present for the past seven years because of the war, but it is being reinstituted this year with even greater fervor. This time, the engineers will not only band together and present with pride the merits of the College, but they will also split up into schools and battle it out for intra-college athletic honors.

The incentive for the rejuvenated and revived Engineers' Day was provided by the newly organized Cornell Student Engineering Council (see photo). After enviously viewing similar programs held in other schools, and even here at Cornell from 1936 to 1941, the Council began to make plans for E-Day almost as soon as its constitution was adopted last December. Then, early this term, they began recruiting students to work on the exhibits to be presented by the various schools and drew up a program of activities for the day.

One of the main purposes of the Council in organizing this rejuvenated Engineers' Day was to provide an incentive for alumni to return to their College, reputed to be one of the best engineering schools in the country. To further this purpose, the Council has asked the CORNELL ENGINEER to present an invitation to all alumni of the College of Engineering to come to Cornell for the weekend of April 23, when they will be guaranteed a show that will make them want to mark down Engineers' Day, 1950, as one not to miss either.

Guests to the campus and students will be treated to a set of exhibits equal if not superior to those presented at the successful E-Days in the past. There will be a tour conducted through the building of each school, with stops and explanations being made at all demonstrations. A small number of the many exhibits being planned are a tour of the micro-wave astronomy lab (see CORNELL ENGINEER, November, 1948) by the E.E. School, photoelasticity demonstration, by the M.E. School, tension testing exhibition by the C.E. School, and a lecture and demonstration of microscopy by the Chemical Engineering School. The Department of Engineering Physics will make use of the Laboratory of Nuclear Studies for its presentation, which may even include a trial run of the synchrotron, in addition to its other demonstrations in electronics and radioactivity.

In the afternoon of E-Day, teams representing each of the schools will battle for the softball championship of the College. The winning team will be presented with a trophy by the Student Engineering Council. This trophy will be inscribed with the name of the winning school, and will remain in that school's building until the 1950 Engineers' Day, when the tussle for the trophy will begin all over again.

Prefacing the revived Engineers' Day will be another revival on the Hill—the Fuertes Memorial Public Speaking Contest, the finals of which will be held on Friday night, April 22. The finalists, all of whom are students of either engineering or architecture, will vie for three prizes totaling $160.

On the whole, the program sounds very promising, and it is hoped that sufficient interest is expressed to make Engineers' Day an annual event, to be participated in by alumni as fully as students.

The CORNELL ENGINEER wishes the Cornell Student Engineering Council success in this, its first major undertaking, and would like to reiterate its invitation to all those interested in the present doings in the Cornell College of Engineering to be here that week-end and take part in the festivities. These begin Friday night with the Fuertes Memorial Public Speaking Contest, continue on Saturday at 2:00 p.m. with the opening of the exhibits in the various engineering buildings which will continue until 9:00 p.m. The athletic competitions will begin at 2:30 p.m. on Upper Alumni Field. All this activity will take place on the *new* Engineers' Day, April 23. We hope to see you there.

The members of the newly organized Cornell Student Engineering Council:

1*st row*: Leonilda Altman, Secretary-Treasurer; Neal FitzSimons, President; David Ross, Vice-president; Mr. John McManus, Faculty Representative.

2*nd row*: Journ Yee, Ernest Dawson, Alfred Blumstein, Leo Sears, William Manogue, William Diefenbach.

3*rd row*: Norman McIver, Walter Crone, J. Perry Barger, George Russell, Gerald Fallon, Robert Burns.

Student-Faculty Lounge

Engineers Will Have a Home in Sibley Dome

By FREDERICK S. TURK, AEME '49

At the present time, a drive is taking place among the undergraduate engineers of Cornell to provide for a Student-Faculty Lounge, to be located in the basement of Sibley Dome. The drive is being carried on by the Mechanical Engineer Honoraries of Kappa Tau Chi, Atmos, and Pi Tau Sigma, with the aid of the Student Engineering Council. It is hoped that $2,000 can be obtained through this drive, and through alumni contributions, to purchase comfortable chairs and couches, and other equipment, and to make a small amount of repairs needed.

Site of Former Lounge

For many years before World War II there was a student-faculty lounge located in the basement of the Dome, for the use of the Engineering College. During the war, this space was appropriated for use as Naval offices and the lounge disappeared. About two years ago, it was brought to the attention of Kappa Tau Chi and Atmos that there was a great need for the re-establishment of the lounge, and these Societies were asked to take this on as a project. The first step in the project was obtaining a room in over-crowded Sibley. After much discussion, and working through the office of Director W. Julian King, of Sibley School, Dean S. C. Hollister agreed that the room in which the lounge had been located before the war might again be used for that purpose. The room is large, well-lighted, and easily accessible through its entrances from the basemen of the Dome and directly from the Quadrangle.

At this point, Creed W. Fulton, then Vice-President of the Cornell Society of Engineers, became interested in the project. After visiting Cornell and approving the room, he volunteered his services, and those of the Society, in a fund raising campaign. Then, before any definite action could be taken, the Greater Cornell Fund Committee issued a blanket rule against drives among alumni other than the drive by the Greater Cornell Fund. This was the situation at the end of the Spring Term, 1948. With the opening of school last fall, Mr. Fulton was contacted and he agreed that it was again time to try for funds for the lounge. Those working on the project attempted to get permission from the Greater Cornell Fund Committee for Mr. Fulton to begin his drive among members of the Society but this permission was denied. Permission was granted, however, for undergraduates to obtain the needed furniture and equipment in any way available to them. This left only two possibilities—contacting alumni and solicitation of funds from undergraduates.

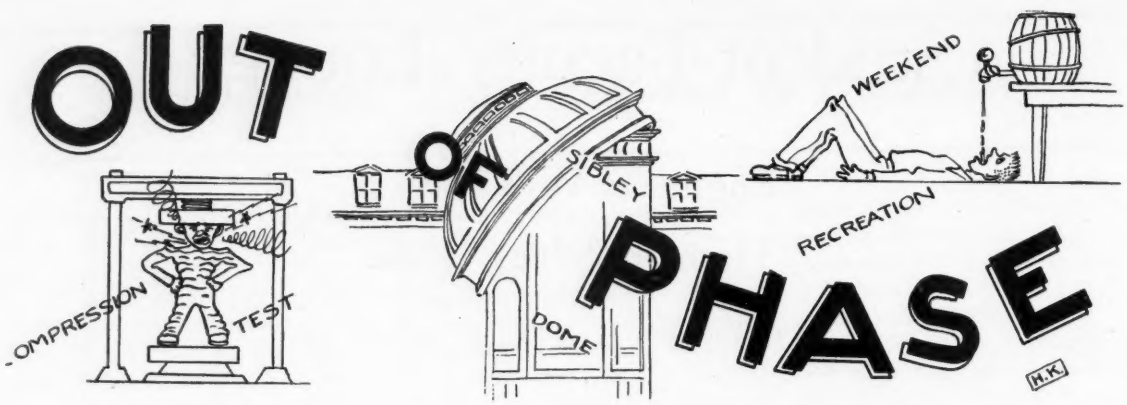
Lounge is Needed

The need for a student-faculty lounge is great. There is no place in the vicinity of the Engineering Buildings where those who spend all their time there can sit, relax, and talk informally. There is no place where students can have a cigarette without going outside or violating the rule against smoking in the buildings. Also, the students of the Engineering College have no place, and therefore no opportunity, to meet and get to know each other. There is no place where the students and faculty can talk informally, working out their mutual problems, outside of the classroom. There is no place where the Engineering Societies and committees may comfortably hold meetings and smokers. The lounge will provide the solution to all these problems and others. Permission has been granted to allow smoking in the lounge. The faculty has no place to rest and relax during their off hours, so they will use the lounge, resulting in closer student-faculty relations. The room is big enough to hold a large number of people at meetings and smokers, without crowding. Another important purpose of the lounge will be to build up the almost non-existant engineering school spirit. Finally, a lounge will make the use of the inadequate buildings more enjoyable and profitable, until the time when the new Engineering College is completed.

Gubb Donates Gift

The most encouraging feature of the drive to provide facilities for the lounge has been the receipt of a new Philco radio-phonograph combination, a gift of Larry E. Gubb, of the Philco Corporation. More gifts like this would rapidly bring the lounge into full existence.

The re-establishment of the Enbineers' Lounge is daily coming nearer and nearer to being a reality. But, help is needed! We ask that every student contribute toward this project, and that every alumnus consider a donation of material and equipment for the lounge. With everyone's assistance, both material and financial, Cornell's engineers will soon be relaxing in their own end of the Quadrangle.



HERBERT F. SPIRER, EP '51

There exists in the School of Electrical Engineering a pleasant old peasant custom called computing laboratories. Officially known as a supervised study period, I would rather consider them a period of supervised boredom, nurtured aggravation, and scientifically administered inefficiency, carefully watched over by competent instructors whose faces show that they would just as soon be somewhere else. However, let us assume for purposes of argument that there is some possible benefit to be gained by spending two and one half hours in such a classroom. If not of educational value, at least it may be considered a help in procuring a degree.

In good old Psych we learned that for the most efficient and beneficial studying, one's surroundings should be restful, with a minimum of noise and distraction. The walls, we were told, should be of a soothing colour, the light strong enough to read by. The desk should be the proper height, the chair comfortable, and the body completely at rest. In short, study periods should be as conducive to personal comfort as possible, since an uncomfortable body induces an uncomfortable mind and an uncomfortable mind is so busy seeking comfort that it has no inclination to seek knowledge. One should not overdo studying, subjects should be alternated hourly, and short rest periods involving yawning, stretching, walking about the room, and looking at pleasant scenery should break every hour of study into several parts.

Important News Item:

Former Engineering College Proctor, Edible J. Parraflop, and a former university instructor, Cadwalder Waddlesplat of Varna, were apprehended last night in connection with alleged illegal tutoring of a Mechanical Engineering student.

According to Patrolman Elmensplat who led a detail of professors and campus patrolmen to the arrest, the pair told officials that they were Ag students and proceeded to explain some of the previous day's classwork to the ME student. No damage was reported done.

The pair was arraigned before the Sibley Board of Trustees for Maintenance of High Standards and Low Marks on a charge of treachery in the third degree.

No doubt the Department heads have also heard of efficient studying. For they set us down, like lambs coralled for the slaughter in a small, foul den. Into a space that would hold about four people (standing) are crowded four long desks. Each of these desks with a minimum of overlapping would accommodate three people. In front of each of these desks they set six chairs. With a minimum of overlapping, these chairs would handle a total of twenty-four people, so they put twenty-five people into the room.

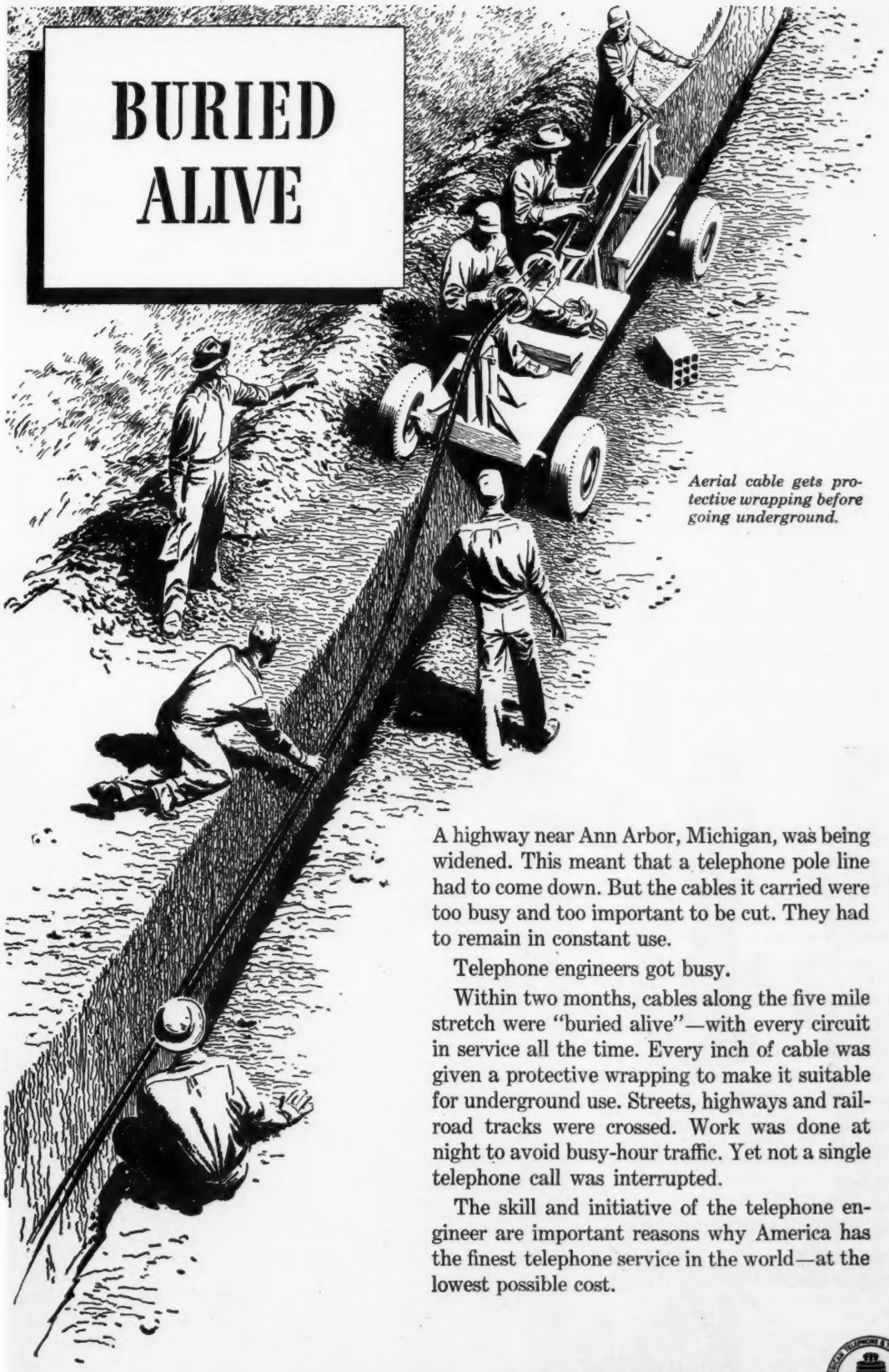
You don't have to know the mass action principle to know that twenty-five is somewhat greater than twenty-four. So someone sits on the desk or floor, or hangs by his toes from the single forty-watt light that drops down from the scarred ceiling. By now, that space at the desks is so cramped that a pigmy writing with a brush which he carried in his mouth would have trouble writing a capital "I". But who's complaining? We students, faithful old dogs that we are, buckle down to work. We learn to write up and down instead of from left to right, so that we don't get too much wear on the elbow from scraping against the next person's ribs. We use dull-pointed pencils because it is dangerous to use ink at such close quarters.

Aren't Windows Wonderful

The surroundings are of similar high quality. What could be more inducive to study than staring at an old shaggy-haired mop, scarred, cheap paper blackboards and sagging splintered floors? Of course, if one wants scenery one can always look out the window. O, window, giver of light, O, window, that brings in scenery, O, window that makes our homes a part of glorious nature! What does one see from the

(Concluded on page 46)

BURIED ALIVE



Aerial cable gets protective wrapping before going underground.

A highway near Ann Arbor, Michigan, was being widened. This meant that a telephone pole line had to come down. But the cables it carried were too busy and too important to be cut. They had to remain in constant use.

Telephone engineers got busy.

Within two months, cables along the five mile stretch were "buried alive"—with every circuit in service all the time. Every inch of cable was given a protective wrapping to make it suitable for underground use. Streets, highways and railroad tracks were crossed. Work was done at night to avoid busy-hour traffic. Yet not a single telephone call was interrupted.

The skill and initiative of the telephone engineer are important reasons why America has the finest telephone service in the world—at the lowest possible cost.

BELL TELEPHONE SYSTEM

Air Transport

(*Continued from page* 9)

its loading and unloading too slow and awkward for good service. Another operating consideration is the variable nature of the load factors of commercial air transportation with respect to schedules of the day, days of the week, and important days of the year. There is practically always a peak load on Friday afternoon and evening, or the day before any holiday. It has been found much more economical and satisfactory to accommodate these peak loads by multiple section operation rather than by increase of unit size which at other times must operate at very low and uneconomical load factors. There is also a direct relationship between size and range and it is obvious that the longer range aircraft, to be economical, must be large.

These considerations, some of which are obviously contradictory, will undoubtedly result in a substantial slowing down of weight and size growth in air transportation. The smallest practical size—a two powerplant type—will, perhaps, be determined, as it has been in the past, by a consideration of the rapidly failing economy with substantially decreasing size which currently appears to peg the minimum desirable air transport unit at twenty to thirty passengers with a relatively small cargo load, and intended for ranges to about 500 miles. The maximum size indicated is a four powerplant type, influenced in size by its probable long range application requiring both high fuel weight load and a good standard of comfort. It may well tend to become somewhat larger than the largest commercial airplane currently available but will not, I believe, exceed 175,000 to 200,000 pounds gross weight in consideration of the negligible economic advantages of further size increase. With respect to maximum range operation, there seems little need, and much economic penalty, in proposing non-stop capacities for commercial use in excess of the 3,500 miles which will span all presently needed overwater or essential overland distances.

We have previously mentioned the growing limitations, as speeds increase, on the efficiency and use of propellers. Long before the airplane itself approaches close to the compressibility problems of transonic flight, the resultant rotational and translational speed of the propeller tip has brought it into that high power-absorbing; high stress-creating and unstable aerodynamic regime. For short range operation at high subsonic speeds where the excessively high fuel consumptions can be tolerated, we may well find turbo-jet designs first applied commercially. And, of course, if and when we pass over into the supersonic range for commercial performance, we will undoubtedly use turbo and ram-jet units.

Air Freight Business

With respect to the carriage of goods by air and the logical development of what surely promises to be

(*Continued on page* 32)

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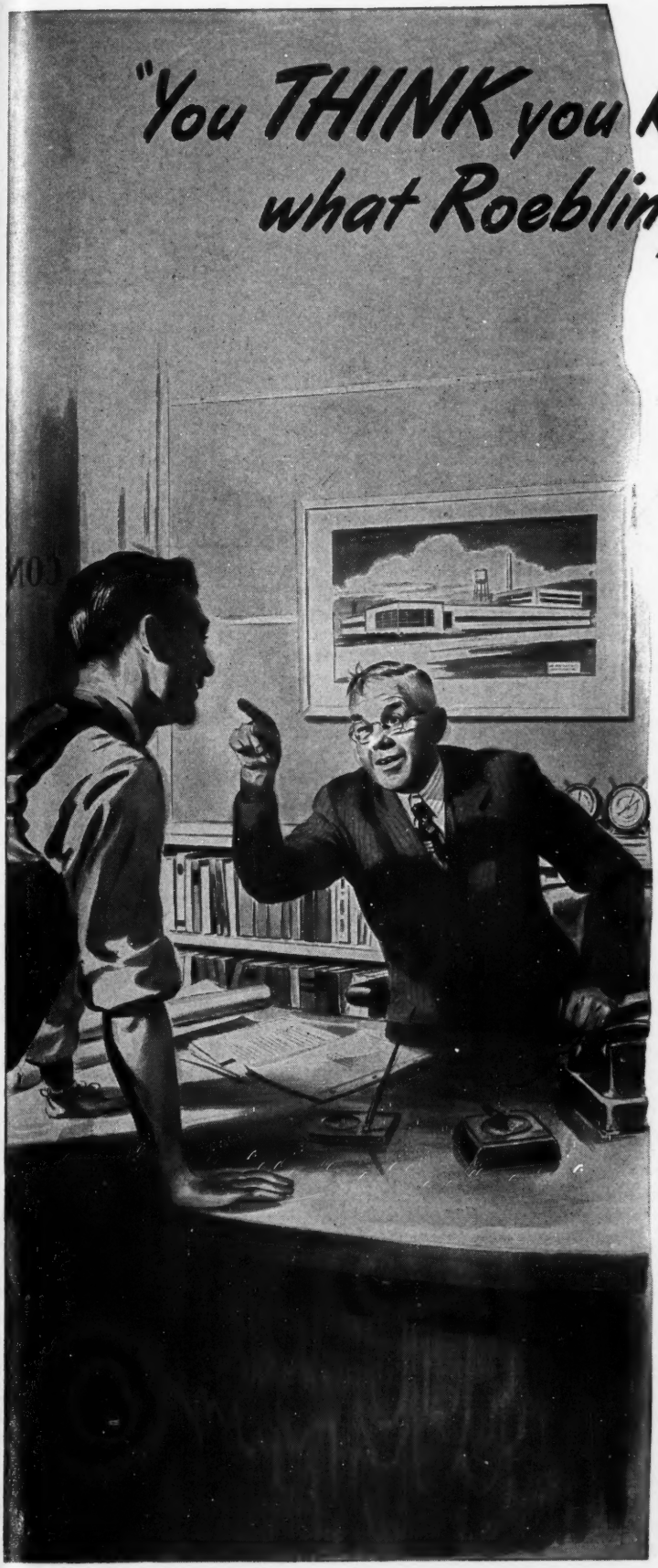

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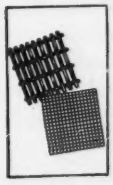

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Air Transport

(*Continued from page* 30)

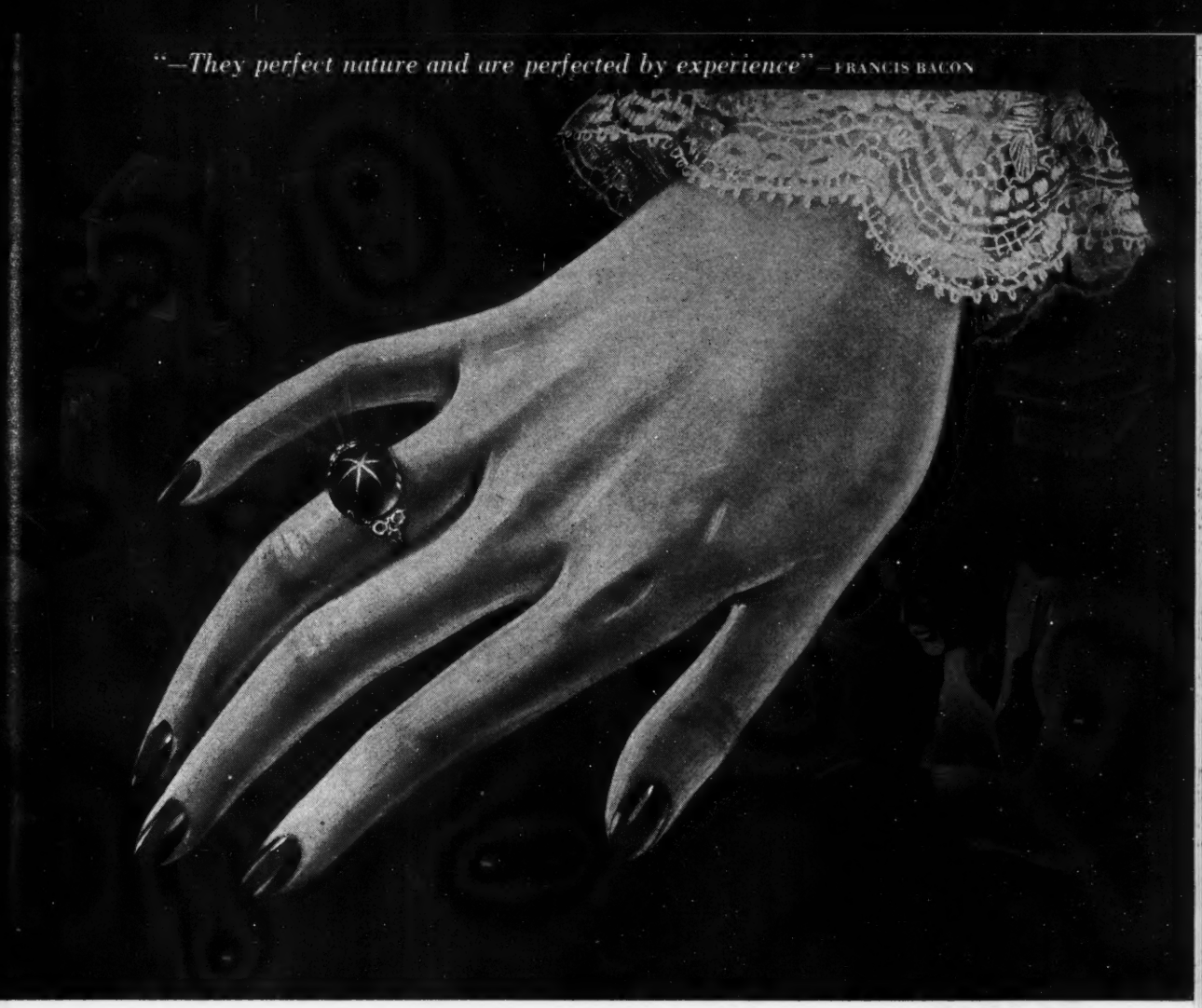
a great airfreight business, it seems reasonable to conclude that for a long time to come, certain amounts of high priority mail and express will be carried on practically all passenger schedules in passenger airplanes. The true airfreight business, however, presupposes the development of an expanding fleet of strictly freight carrying airplanes whose operation is geared directly to the needs of industry. It is obvious that the time advantages already available over competing forms of freight transportation are so great that no additional incentive is necessary in the field of speed. It is equally clear that some of the same basic factors influence the growth of airfreight as control the destiny of passenger transportation. Those factors are guaranteed regularity and punctuality of service, and economy. While these factors are probably in their proper order of significance with reference to passenger service, it might be argued that economy should be listed first with respect to airfreight. It would seem that our airfreight airplanes need not go much faster than the 300 miles per hour available with equipment of today unless such increases of speed can be achieved with no sacrifice of efficiency, and hopefully, with improved economy. Such a trend, while apparently contrary to the normal engineering expectation, is entirely within the realms of possibility as has been accomplished in the past by refinement and rebalancing of the complex factors which control over-all design. Our present day airplanes provide a ton-mile result at 300 miles per hour at lower cost than the airplanes of fifteen years ago, when airplanes gave a ton-mile at less than 200 miles per hour.

Heavy Load Air Freighters

Our airfreighters may be somewhat larger than the present 20,000 pound and contemplated 30,000 pound capacities, providing that the growth of the business justifies such larger unit sizes. The influence of the military transport and cargo requirements, particularly if brought to play through the Federal support of prototype development, will tend to result in a larger unit than might otherwise be commercially desired. The same size principles apply to airfreight as to passenger service, however, and it is believed to be a grave error to lean too heavily toward large size as a desirable basic factor in design. In over-all commercial economy, it is apparent that efficiency argues for the availability of a unit which is occasionally too small for the needs so that the majority of the time it may not be too large for the requirements.

Probably the most frequently used word in reference to commercial air transportation is safety. The industry must continue to exercise its very best efforts in that respect. Simplification and standardization, now rather deplorably lacking, are probably two of the

(*Concluded on page* 34)



What these man-made gems mean to you

SYNTHETIC STAR SAPPHIRES like this one, which only the finest of nature's stones can equal, are now made by *man.*

Yes, Union Carbide—which since 1942 has made synthetic crystals for precision instruments and other industrial uses—today produces the loveliest of synthetic star sapphires *and* rubies for personal wear.

But far more important to all of us are the research and technical skills . . . the work with extremes of heat and cold, with vacuums and tremendous pressures . . . that lie behind these superb jewels. The research and skills that produce today's *better materials* . . . used by industry in turning out numberless products.

The same research that brings these man-made stars within our reach . . . brings us, too, man-made leather and rubber. It also gives us today's *better* food, clothing, and shelter. It helps us resist disease. It improves our heating and lighting. It's a part of our swifter, safer transportation systems . . . our communications . . . our progress in construction.

The people of Union Carbide work with a vast range of Alloys, Chemicals, Carbons, Gases, and Plastics. They are constantly perfecting new processes . . . and producing hundreds of materials . . . for the use of science and industry to benefit mankind.

FREE: *You are invited to send for the new illustrated booklet, "Products and Processes," which shows how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics.*

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PRESTONE and TREK Anti-Freezes • SYNTHETIC ORGANIC CHEMICALS • ELECTROMET Alloys and Metals • HAYNES STELLITE Alloys

Air Transport

(*Continued from page 32*)

major engineering contributions which can be made. However, the references to safety are frequently mis-applied, for the record of commercial aviation in passenger safety will easily bear the closest scrutiny in comparison with any other transportation efforts in the world. The record is good, and can and will be better, but the frequent reference to safety is often occasioned not so much by a knowledge or appreciation of the actual safety statistics, but by a too often unfortunate and justifiably criticized lack of regularity, punctuality and reassuring comfort in commercial flight. The solution of these problems more than any others, will be a mark of the maturity and sound establishment of air transportation. The problems are very complex and involve the difficulties of on-time departures and arrivals under all, or nearly all, weather conditions, and the intermediate provision of a smooth, comfortable and reassuring flight. This complex set of problems is a field of major endeavor in the engineering and operational activities of the Federal agencies, airlines and equipment manufacturers. The problem in its broad scope is of the greatest interest and importance to all flight activities—military, commercial and private.

In Conclusion

Most of the trends we have discussed are potentially inimical to economy. To state it conversely, economy may well determine the extent to which the trends are followed. Inherently, speed is accomplished at the expense of power or fuel, and with some of the advanced methods for the production of thrust, economy is even more necessarily sacrificed to performance. If we are to have more speed, then, and we undoubtedly will demand more as time goes on, we must, barring some hoped for developments such as boundary layer control, or the discovery of new principles for producing high lift and control at low speed, be prepared to pay a price for it—how much, depends on how much speed we want. It is also true that increased size of a given type of airplane tends to bring with it reduced costs per unit mile, but we have listed a number of the practical reasons why size growth will not proceed apace, thus blocking off that avenue to the occasional economies indicated. Engineering refinement, standardization and simplification are all healthy activities for promoting economy, but the over-all picture is one of conflicting trends, and it appears that we cannot anticipate much in the future in reduced costs per weight unit mile per hour. On the other hand, there seems no reason why we should not be prepared to pay a price which bears some proper relationship to the service rendered. Speed is certainly worth money—both with respect to people and goods—and when that speed is supplied with the required regularity and puctuality and reassuring comfort, there will be little complaint about the price charged or value received.

FACTS ABOUT SKF

HOW BALLS ARE MADE ROUND!

The making of steel balls is similar in principle to Grandma's method of forming and rolling butter between two paddles. In large lots, the balls are put through a succession of grinding machines, each machine doing a finer job than the last, until accuracy of one 25-millionth of an inch has been achieved. SKF Industries, Inc., Philadelphia 32, Pa. 6591

SKF
BALL & ROLLER BEARINGS

● *Send for a free copy of Catalog No. 263, "How Are Balls Made Round?"*

New RCA 16-inch direct-view television tube fills gap between popular 10-inch tubes and the projection-type receivers.

"Inside story" of a bigger, brighter picture on your television screen

The screen on which you are accustomed to seeing television is the face of an electron tube—on which electrons "paint" pictures in motion.

And the size of the picture, unless projected, is determined by the size of the tube.

Working to give you *bigger*, brighter pictures, RCA engineers and scientists developed a new way to make large, direct-view television tubes. They found a method of "welding" large areas of glass and metal . . . while keeping a vacuum-tight seal!

Using this development—ideally suited to mass production—RCA can now build television tubes of light, tough metal . . . using polished glass for the face, or "screen."

An achievement of research

Development of this new way of making television tubes is a continuation of *basic television research* which began at RCA Laboratories. Such leadership in science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

. . .

Examples of the newest advances in radio, television, and electronics—in action—*may be seen at RCA Exhibition Hall, 36 W. 49th St., New York. Admission is free. Radio Corporation of America, Radio City, N. Y. 20.*

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

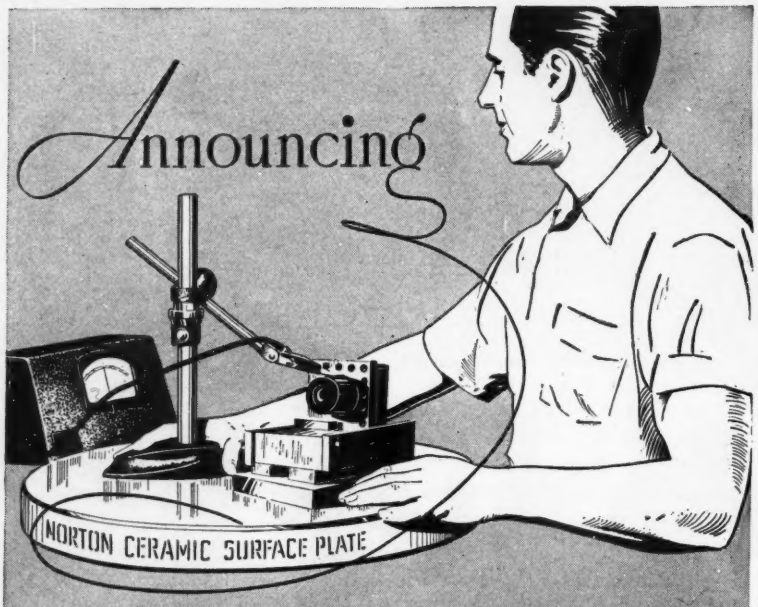
- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television



Another NORTON "FIRST"

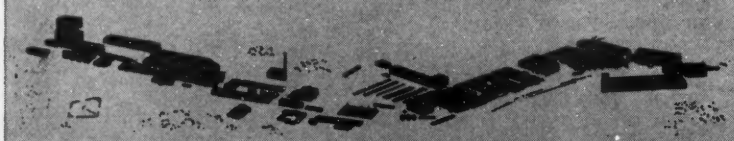
THIS time it's a *ceramic* surface plate—an entirely new type of plate for toolmakers and inspectors to use in making their precise measurements. This Norton-developed ceramic plate has distinct advantages over previous types of surface plates including: (1) a longer-lived surface, (2) a smoother surface, (3) a flatter surface and one that *stays* flat. It will not warp nor deform, not sweat nor corrode, not deflect under load.

The development of this unique surface plate is typical of the progressive research that has made Norton an acknowledged leader—not only in abrasives and grinding wheels but also in the development of grinding and lapping machines, high temperature refractories and a wide variety of wear-resistant materials.

In the Norton laboratories at Worcester, Chippawa and Troy, there are 195 scientists, engineers and technicians constantly at work on new or improved Norton products.

NORTON COMPANY, WORCESTER 6, MASS.

Behr-Manning, Troy, N. Y., is a Norton Division



The main Worcester plant of Norton Company—world's largest producer of abrasive products

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ABRASIVES — GRINDING WHEELS — GRINDING AND LAPPING MACHINES
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LABELING MACHINES (BEHR-MANNING DIVISION COATED ABRASIVES AND SHARPENING STONES)

Prominent Engineers

(*Continued from page 25*)

Joe Quinn

service teams. Joe was discharged in November 1945 and immediately entered Cornell as a BME candidate. He later decided that he was more interested in the administrative side of engineering, and made the small jump to AEME.

Joe has been on the football team for four years and served as captain last fall. His fine playing at left guard was an integral part of the drive that gained the Ivy League crown for Cornell in 1948. Joe received national recognition in being elected to the third string All-America team for 1948 and in playing on the North's squad in the North-South game last Christmas night.

In addition to football, Joe has been playing lacrosse since 1946. He was president of Aleph Semach, the junior honorary society, and is a member of Quill and Dagger, the Newman Club, and Atmos. He is also president of the football club and president of Sigma Nu fraternity.

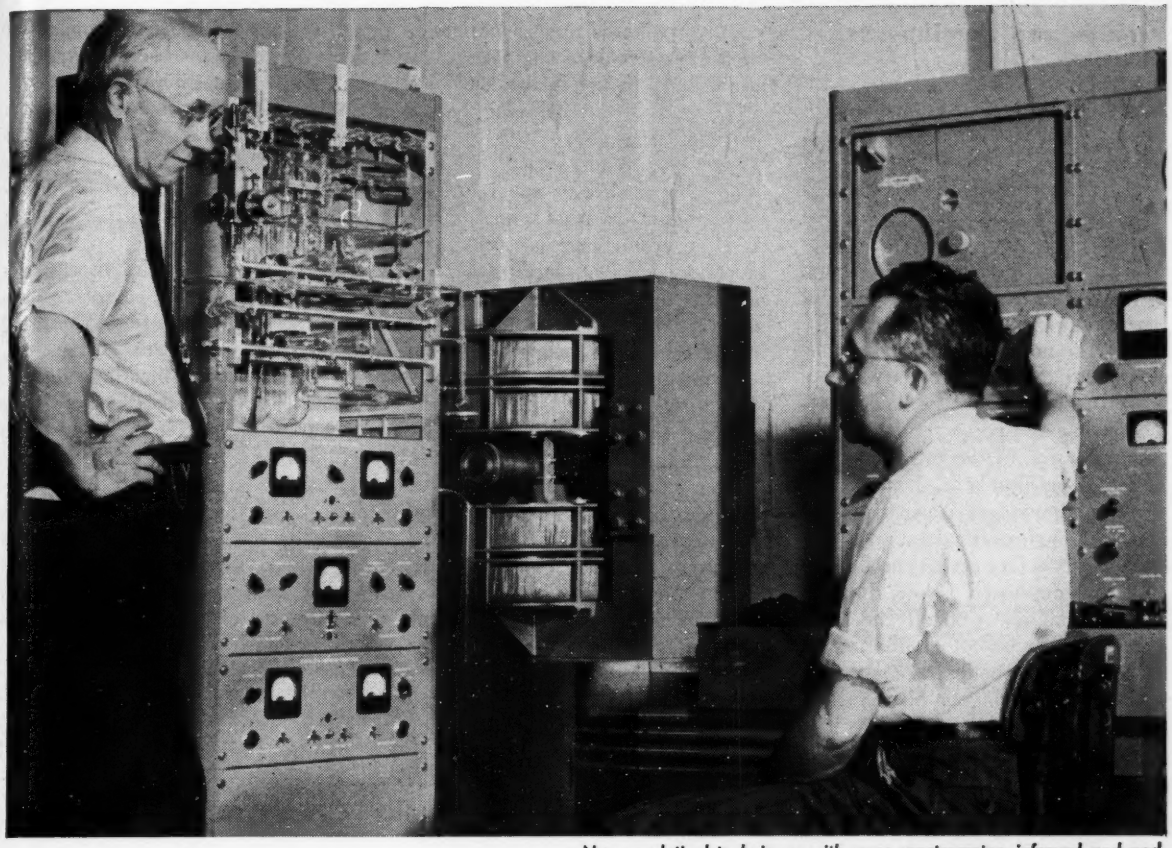
Joe has not decided what he will do after graduation in June, but he is considering either doing graduate work in the business school or entering industry.

Ken Canfield

varsity and then the varsity the following year. That summer found him in Delaware, working for the Hercules Powder Company and learning to play golf on the course surrounding the plant.

Ken returned to Ithaca this September, a senior and a married man, but still keeps up his activities, maintains his marks, works part time, and is active in his fraternity, Tau Kappa Epsilon. Ken's energy and ability have won him membership in Pros-Ops, Tau Beta Pi, and Sphinx Head, and also a McMullen scholarship.

Ken has had several offers for employment, and is currently investigating each carefully as to the proximity of golf courses and adjoining lakes before he makes any decision.



New analytical techniques with mass spectrometer, infrared and pod equipment. Refinery Chief Chemist G. Lansing, Washington & Jefferson, '11, Cincinnati '17, J. A. Simpson, N. Y. U. '38, Stevens '43.

What should a man work For?...

Put that question to either of the men shown here, and he'd answer about like this:

"Well, you could say a man works for a living, but there's more to it than just that. A man has his self-respect to keep. He wants to work at a job he likes. He wants to do something useful. He wants fair pay and steady hours—with some time to himself and his family. He wants a chance to get ahead and he wants to save some money. And he wants some security in case of accident or sickness. Then, when his working years are done, he wants to know he can retire on an annuity."

Today, in Esso Standard Oil Company, 28,000 men and women have jobs which offer exactly these things.

They have such jobs because of a company policy that was set up over 30 years ago—and developed side-by-side with our workers ever since. It is a policy based on the belief that the heart of a business is its people—that the best possible jobs attract the best possible workers.

Workers in this company today have everything outlined in the statement above—including vacations with pay, sickness benefits, cash savings in a Thrift Plan, and the opportunity to retire with income for life.

Our 28,000 workers, for instance, have now been with us on the average for 12 years—8,400 of them more than 20 years.

But this policy hasn't grown from "generosity" alone. It's a practical, common-sense *business* policy, and a good one. Because we know that the best way for Esso Standard to help meet the growing oil needs of the world is . . . by doing our best to help our workers get "the things a man works for."

Esso

ESSO STANDARD OIL COMPANY

Engineering Enrollments

(*Continued from page* 12)

the declining birth rate of the '30's brought about a dip which was accelerated by the war. The peak college enrollment of 1946 is not directly related to any point on Curve (A), of course, since it represents a compression of several years of normal enrollment plus the stimulation of the G.I. Bill.

We are now again on an ascending portion of the secondary school curve, but significantly, some 300,000 below the point resulting from the extension of the pre-war trend. There is nothing here, then, to indicate an upward variation from the pre-war engineering freshman gradient, and in fact actual enrollments may be depressed below the gradient for a few years if the influence of high school graduations is maintained as before. Sometime in the 1960's the higher birth rate of the 1940's should elevate the high school curve, and the college curve may then be influenced accordingly.

Evidently the predictions of oversupply are based upon a projection of the high peak of engineering enrollments into the future, and thus they assume a continuing output of engineers above the pre-war norm. The trend towards the normal pattern already apparent does not support any such view.

The second part of the whole question, that of demand for engineers, involves a host of supplementary factors. The current demand for engineering graduates is, of course, well above pre-war demand, reflecting at least in part the the war-time shortage of engineering graduates. Any tightening in the employment situation, if it occurs at all, will probably come about in the next two years when graduations are at a peak. Thereafter the decline in graduations toward— and perhaps below—the norm should indicate a good outlook for engineering employment in the next decade. Of course any severe economic collapse might upset this view, but this problem would then not be peculiar to the engineering profession.

In considering employment it may be well to question the validity of simply extending the pre-war pattern. If we consider such factors as the far-reaching scientific and technological advances of the past few years, the vast increase in industrial productive capacity and in new industries, the engineering challenge of our diminishing resources, the use of engineers outside the profession—all of these and many others may cause a sharp upward trend in engineering employment. It would seem therefore, that the pre-war pattern of engineering employment might well be ultra-conservative so that a return to the pre-war graduation gradient might actually indicate an under-supply of engineers over the next decade.

The progress and security of the nation are closely dependent upon the strength of the engineering profession. We have a serious obligation, therefore, to safeguard the vitality of the profession through a healthy addition to its ranks and through vigorous support of its intellectual development.

LAVA

Manufacturers of Super-Refractories Only

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REFRACTORY CRUCIBLES
GRAPHITE CRUCIBLES
HIGH-TEMPERTURE CEMENTS
SPECIAL REFRACTORY BRICK, TILE, SHAPES

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MAGNESIA ZIRCON

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LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittsburgh, Pennsylvania

what the well-jacketed cable is wearing

THIS smooth outer jacket of Okoprene may be good-looking but it's chosen for service and not style. As its name suggests, Okoprene is a neoprene compound, a cable covering pioneered in the Okonite laboratories, developed to give electrical wires and cables the combination of properties demanded by severe usage.

Specifically Okoprene resists corrosion, resists oils and acids, is non-flammable. It is not only ozone resistant but it does not develop static discharge below 5000 volts. It has been proved electrically stable and mechanically strong on millions of feet of cable installed since 1935. The Okonite Company, Passaic, New Jersey.

6966

OKONITE SINCE 1878

insulated wires and cables

SPRING, BEAUTIFUL SPRING!

We can't hardly wait to display our new Spring merchandise for

EQUIPMENT
for

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TENNIS **GOLF** **BADMINTON**

A NEW LINE OF SPORT SHIRTS FROM CALIFORNIA

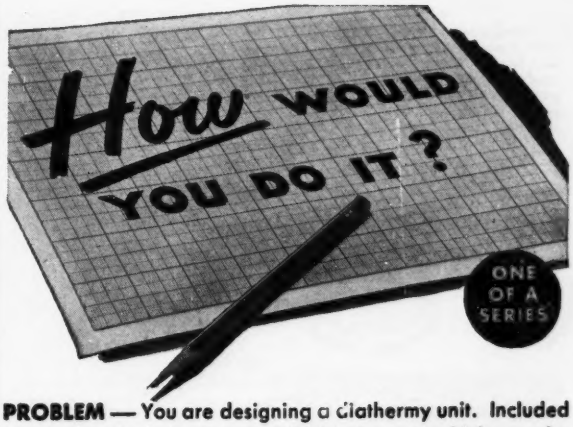
THOSE POPULAR JANTZEN SWIM TRUNKS, SHORTS & SPORT SHIRTS

REIS GAUCHO SHIRTS AND TURTLE-NECK T-SHIRTS IN SPRING COLORS

We have your equipment and your clothing for Spring and Summer sports and we have a dividend too.

THE CORNELL CO-OP

Barnes Hall On The Campus



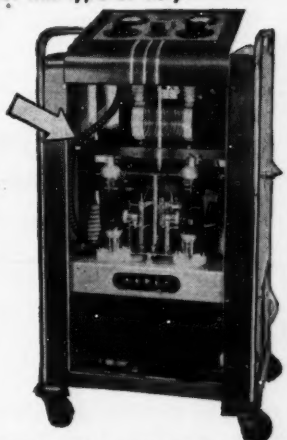
PROBLEM — You are designing a diathermy unit. Included in the electrical circuit are variable elements which must be adjusted during operation. The control knobs must be located where they will be convenient to the operator. The variable elements themselves must be located in the cabinet where they will be easy to mount, to wire and to service. How would you do it?

THE SIMPLE ANSWER — Use an S.S.White remote control type flexible shaft to couple each variable element to its control knob. This simple arrangement makes it possible to place the elements and their controls anywhere you want them. And you will find, too, that operation with these shafts is as smooth and sensitive as a direct connection, because S.S.White remote control flexible shafts are designed and built especially for this type of duty.

* * *

This is just one of hundreds of remote control and power drive problems to which S.S.White flexible shafts provide a simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles"* for mechanical bodies.

*Trademark Reg. U. S. Pat. Off. and elsewhere



Here's how one well known electronic equipment manufacturer did it. The flexible shaft (arrow) connects control knob at top to a variable element at the bottom rear.

WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. A copy is yours free for asking. Write today.

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FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL PRIMEMOLA CHUCKS
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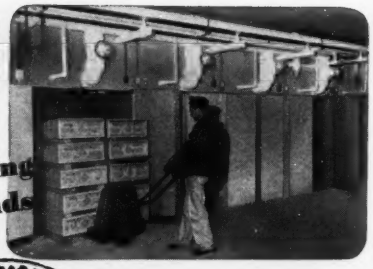
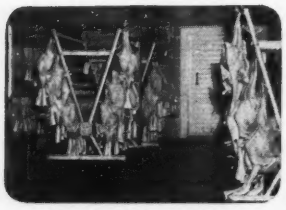
One of America's AAAA Industrial Enterprises

Unloading one of the 15 Frick Blizzard Freezers at Mt. Vernon, Wash. Temperature is 40° below 0. Installed by Lewis Refrigeration & Supply Co., Seattle.



Quick-freezing 80,000 Pounds of Poultry with FRICK Refrigeration

That's just one day's work at the new plant of the Washington Co-Operative Farmers Assn. But it means 16,000 chickens or 4,000 turkeys have to be processed, precooled, quick-frozen, and stored at zero.

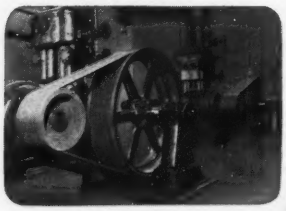


Precooling Poultry at 33° F.

Frick Refrigeration carries the entire cooling load at this Mt. Vernon, Washington plant—just as it does in the world's largest quick-freezer, across the continent at Bridgeton, N. J.

If you're anywhere in between, and need refrigeration, get in touch with the nearest Frick Branch Office.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, Offers a Career in a Growing Industry.



Two of Five Frick Compressors

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The best in Slide Rules

K & E
Log Log Duplex decitrig
$20.50

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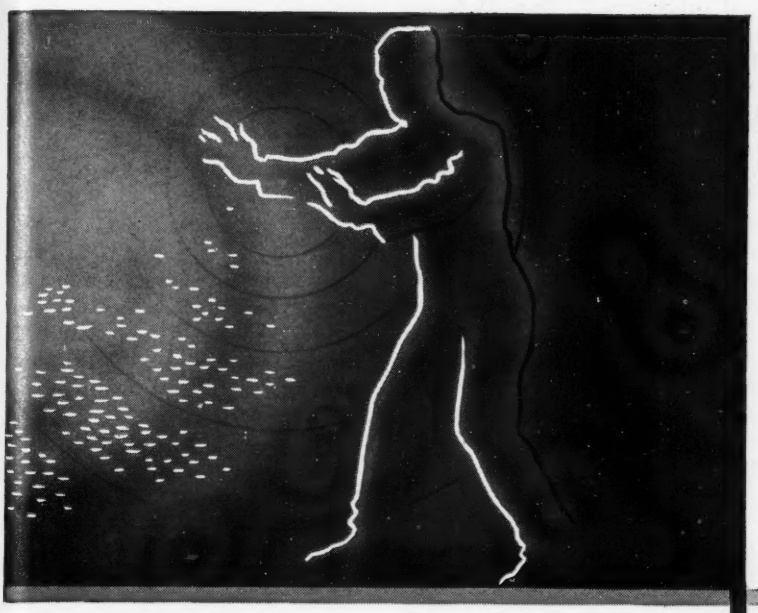
Sailing

(*Continued from page* 15)

sure. The two crafts perform in a nearly equal fashion before the wind. With these differences in mind, it can be seen that, in a race, it is sometimes of advantage for the skipper of a gaff-rigged boat to make his down-wind run in a series of very broad reaches while the Marconi skipper must never do so except, of course, as tactics require.

The modern racing class boat will in almost all cases feature a jib as part of its fundamental design. The advantage gained appears as a result of an investigation similar to the ones described above. Free small pieces of down in various spots along the lee side of the mainsail of a cat-rigged boat (i.e. no jib), and they will exhibit highly irregular motion, hinting at considerable eddy production here, which, by destroying the Bernoulli effect, is very damaging to the action of the sail. Then when the jib is set, down freed as above will travel quickly aft evidencing little eddy formation. The action of the jib then is to direct a stream of air aft along the lee side of the mainsail. In addition to this, the jib helps the formation of the large eddy on the windward side of the mainsail and then blocks it before it has a chance to dissipate its energy in small eddies. The mainsail likewise aids in the draw of the jib by directing on its after portions such air as glances off the luff of the mainsail. The jib should be set so as to overlap the mainsail above one-third of the boom length past the mast in order to promote all these effects.

Many other important and edifying facts have been and remain to be discovered concerning the science of sail and all contribute to a greater understanding and appreciation of the sport. A boat in the hands of a skipper who knows the why of his technique is a more feared opponent than the one who relies only on what he calls "feel," despite the fact that that is itself a prime requisite to successful sailing. And, in fine, a sailboat is a greater joy and a greater satisfaction to the skipper who knows the reasons for the design of his craft and for his handling of it, to which end this article serves merely as an introduction.



Blind man's buff

Blind man's buff is an expensive game to play with alloy steels. It is safer to go directly to the steel that will give the best performance at the lowest cost per finished part.

Molybdenum steels have shown time and again that they will provide consistently good properties at surprisingly low cost. Even their impact strength is consistent because they are not temper brittle.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS

Climax Molybdenum Company
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MOLY

C3

City Planning

(*Continued from page* 11)

and reasonable environment for his home.

Most of the escapee-inhabited suburbs, however, have not been different in physical organization from the city that has been left behind. The one great advantage is less concentration of people on the land and of vehicles in the streets.

Superblock Is Basic Residential Element

Only within the last twenty years have we begun to design residential areas in accordance with standards based on contemporary requirements. The first concrete application of these standards was made in the town of Radburn, N. J., begun in 1928 as an entirely new community in the New York Metropolitan area, and widely heralded as the "Town of the Motor Age." The depression put an end to the construction but not before a good start had been made. The old gridiron street system, which had been used either straight or with fanciful variations in so many New Jersey subdivisions, was abandoned altogether in Radburn. The basic residential area was the "super-block," a piece of land of irregular shape, several times as large as the usual city block. Bounding the superblock were the streets or traffic ways. These streets were far different in appearance from the ordinary suburan street. They had no sidwalks and no houses fronted on them. The houses all fronted on short dead-end streets or *culs-de-sac* extending like fingers into the interior of the block. The interior was developed as a park. The pedestrian circulation system was divorced entirely from the vehicular circulation system. In place of sidewalks along the street, all the houses were connected with footpaths which went through the interior park. Where they crossed the principle streets, the footpaths were depressed in underpasses. It was possible for a child (who went where he was supposed to go) to get from his home to school without crossing any street or even walking beside a street. All major traffic was channelized around the periphery of the super-block; the only traffic on the *culs-de-sac* which gave access to the houses was that traffic serving those dozen or so houses.

The Radburn prototype, designed by Henry Wright and Clarence Stein, has had a most pronounced influence on later planned developments, both for new areas outside existing cities and for redevelopment schemes for cleared areas within cities.

The principles of the super-block, the houses on minor service ways, and the separation of motor and pedestrian ways were incorporated in the three so-called greenbelt towns* built by the Resettlement Administration of the U.S. Department of Agriculture as models of

*Greenbelt, Md., near Washington, D.C., Greenhills, Ohio, near Cincinnati, and Greendale, Wis., near Milwaukee.

(*Continued on page* 44)

MACWHYTE WIRE ROPE

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A STUDENT ARTICLE CONTEST

To foster interest in the field of engineering journalism, the CORNELL ENGINEER will award next year an engineering handbook or the cash equivalent to the author of the best student-written article accepted for publication in the magazine during the school year 1949-50. All undergraduates in engineering and architecture are eligible, except board members of the ENGINEER.

Articles should be semi-technical in nature and about 1500-2000 words in length. For submission, they should be typed double-spaced and accompanied by a list of available illustrative material. The deadline for articles to be considered will be announced in the Fall.

Final judgment of all material rests with the editorial board of—

THE CORNELL ENGINEER

Room 400 Lincoln Hall

DU PONT Digest

For Students of Science and Engineering

Chemists in Pictures

How Du Pont and studio scientists solved the problem of noisy film

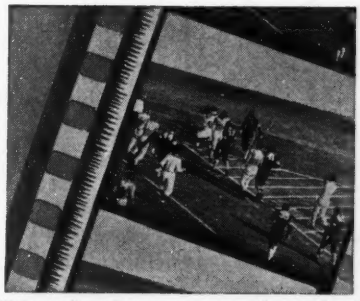
Who'd ever expect to find Du Pont chemists in Hollywood? When motion pictures suddenly started to talk, a whole new series of perplexing scientific problems was born, not the least of which was "noisy" film.

As you know, sound is usually recorded directly on film. If you hold a strip of motion picture film to the light, the sound track is seen as a narrow band of irregular lines. A light ray passing through the moving sound track falls on a photocell with rapid interruptions or changes in intensity. The photocell converts these interruptions into electrical impulses which, amplified, reach the theater audience as voice and music.

If the film has a coarse grain structure, it tends to give lines that are not sharp and uniform in density. Such irregularities interrupt the light ray—come out as distracting noise.

What could be done about it? Du Pont scientists of the Photo Products Department started a program of research, in cooperation with technical experts from the studios in Hollywood. They made and tested scores of film coatings. Finally there were developed films of exceedingly fine grain structures.

M-G-M and Paramount were among the first to use the new type Du Pont films. The development was heralded by the press as "another milestone in the technical progress of the industry," and in 1943 Du Pont received an Academy Award of Merit for its achievement. Now the use of fine grain films is practically universal in Hollywood. Actors, actresses speak their lines, with no technical restrictions to cramp their artistry.

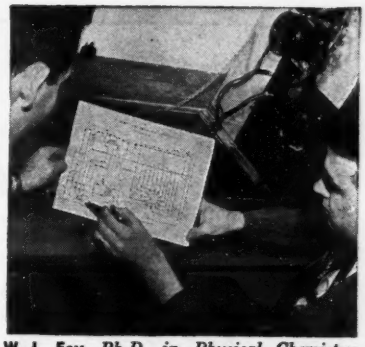


Voice and music *appear as a continuous band of irregular lines on this movie sound track. Any irregularity means noise.*

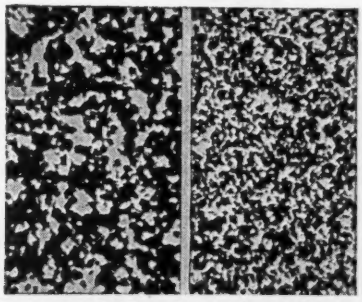
You may have a place in Du Pont research

Had you been a member of a Du Pont Photo Products research team since 1931, you might have shared in many outstanding achievements, two of which have been recognized by "Oscars."

Achievements *of Du Pont scientists over the years have won two "Oscars" from Academy of Motion Picture Arts and Sciences.*



W. L. Foy, *Ph.D. in Physical Chemistry, Clark University, 1947, and A. C. Lapsley, Ph.D. in Physics, Virginia, 1947, discussing details of Color Densitometer Wiring Diagram used in connection with research on color photography.*



In coarse grain films, *the particles of silver are large and scattered. Compare with Du Pont fine grain film, right. (Magnified 1000 times.)*

The Photo Products Department, however, is just one of ten Du Pont manufacturing departments, all of which engage in continuous research. Operated much like separate companies, each holds challenging opportunities for young, college-trained chemists, engineers and physicists. Du Pont not only tries to select young men and women of promise, but makes a conscientious effort to help each one develop as rapidly as possible. Whatever your interests, you will find here the cooperation and friendly interest you need to do your best. As a member of a small, congenial working team, your ability can be seen, recognized and rewarded.

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City Planning

(*Continued from page* 42)

sound planning practice during the 1930's. They were used in dozens of war-time housing developments, including Vanport City, Oregon, which became the second largest city in that state.

Rebuilding Communities

More spectacular than the development of new communities, is the application of this new scale in rebuilding blighted areas of our old cities. The reason for the flight to the suburbs is not an overwhelming desire to spend two or more hours a day on crowded commuters trains and busses. It is only because they cannot find the environmental amenities they seek in the city that families move outside. The rehabilitation of our cities can be accomplished and must be accomplished. In many cases this will involve the wiping out of the old street pattern and the substitution of something resembling the super-block system. A new concept of scale is necessary. If any significant reconstruction is to be done, it will have to be approached in a bold fashion. It cannot be done by dealing with individual buildings or single blocks. Whole sections of the city must be replanned and rebuilt at once. The solution must be sought on a neighborhood basis. Particularly for residential areas, a new environment must be created.

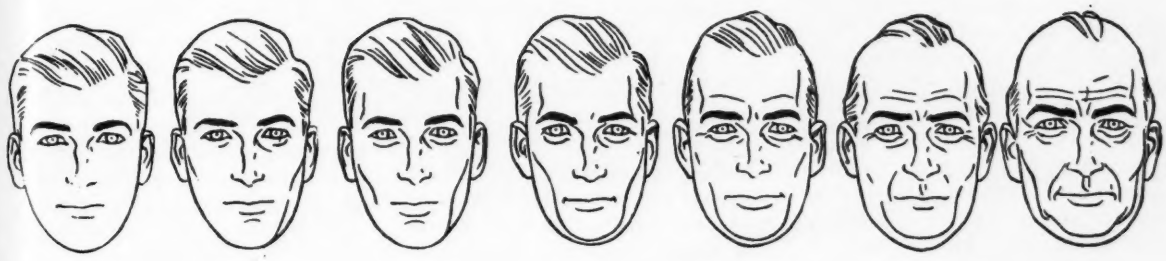
In the past fifteen years this approach has been followed in the design of housing developments, both private and publicly assisted. The largest of these developments is Parkchester, a community of more than 40,000 people, developed before the war by the Metropolitan Life Insurance Company in the Bronx, New York City. This was built on a vacant tract of 130 acres around which the city had grown. If the existing street pattern in the vicinity had simply been extended through this site, it would have been divided into 43 city blocks and 32.5 per cent of the total area would have been in streets. Instead, the tract was divided into four great super-blocks, two principal streets intersecting in the middle. Only 21.2 per cent of the area is in streets and the building coverage amounts to only 27.4 per cent of the total. Each of the four quadrants has a central park and children's playgrounds.

Used in Manhattan

This new scale in city planning is now being applied extensively along the east side of Manhattan from the Brooklyn Bridge to the United Nations site north of 42nd. Street. Here along the river front, the city is being rebuilt in a bold fashion by public and private agencies. The old street pattern is being wiped out and the land consolidated in large tracts for redevelopment. The United Nations site includes six city blocks, the proposed New York University Medical Center will extend from 30th to 34th

(*Continued on page* 46)

When Does An Engineer Finish Exams?



The answer, of course, is never—*not as long as he continues to be an engineer.* As an engineer, every problem put to you, in school and out, will always test your professional skill and ingenuity. The next step, then, is to *make sure you'll always pass.*

Today you're passing those exams with the information you're getting out of books, lectures and the laboratory. Tomorrow, when you are out on the job, the lectures and the laboratory will be gone. But your engineering books will always be there, and to them you will add the business and technical magazines devoted to your special branch of work.

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HEADQUARTERS FOR TECHNICAL INFORMATION

330 West 42nd Street, New York 18, N. Y.

Out of Phase

(*Continued from page* 28)

computing room window? One sees that crouchering lecherous monster, that architectural blot on the good name of humanity—Franklin Annex.

. . . There you are, pencil in your teeth, book held under the table where there is almost room enough for it, looking only at your paper for fear of being influenced by the doleur of the immediate surroundings, miserably shivering or sweating furiously depending on which part of the room you are in, and then what happens: The person next to you is a mutter-mumbler. Not the ordinary kind of mutter-mumbler, but the special variety. The kind that not only mutter-mumbles about the problems he is doing, but also mutter-mumbles about everything that has happened to him since the age of two. He mutter-mumbles about the ratio of e to m, he mutter-mumbles about the rotten mark he got on the last prelim (98), he mutter-mumbles about how much better the veterans have it—especially the married ones—he mutter-mumbles about his courses, his grandmother's courses. But you get used to mutter-mumbling; your shoulders are broad.

Then what happens: The character on the other side, one Festerface Peep, is a kicker. You all know what a kicker is. No matter how much room there is under the table, there just isn't quite room enough for his corkscrew legs and elongated feet. He tries to make room by gently nudging you with his hobnailed boots. You give way under the onslaught. You have your legs wrapped around each other in the smallest possible space like double conductor twisted cable. You wonder, "Will I ever walk again?" and your legs answer "You silly boy!"

But, like all kickers, he is not satisfied with tying you in knots. Once he has the upper hand he becomes a twidget. A twidget is a person who—uh—ah—twidgets. As he

(*Concluded on page* 48)

City Planning

(*Continued from page* 44)

Streets over four blocks, and the Stuyvesant Town housing development of the Metropolitan Life Insurance Company, now nearing completion, is built over eighteen city blocks. The old streets running through the site were wiped out and traffic has been channelized around the boundaries of the site on widened streets.

The principles of design and construction of complete neighborhoods whether in the suburbs or within the city constitute a partial answer, at any rate, to the challenge of the technological society of today for better urban environment.

It is not a theoretical, academic solution but a practical answer, possible to achieve within the existing social and political structure. This approach will not create any metropolitan or suburban Utopias but it is a direct response to a compelling condition.

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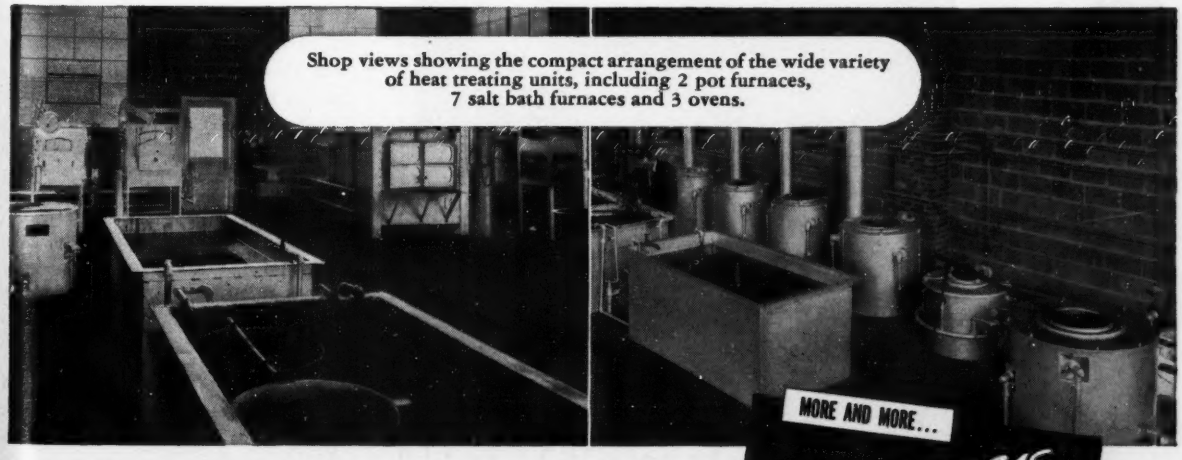

Shop views showing the compact arrangement of the wide variety of heat treating units, including 2 pot furnaces, 7 salt bath furnaces and 3 ovens.

AMERICAN GAS ASSOCIATION
420 LEXINGTON AVE., NEW YORK 17, N. Y.

Out of Phase

(*Continued from page 46*)

works and thinks, his feet twidge, his body squirms. The problem with twidgets is that they have to have something to twidge against. The nearest sensitive organisms are your legs. So he places the metal tipped toe of his shoe against your rapidly solidifying legs, and there he twidgets away. Bump, bump, push-push-push-jitter, jit-jit-jit-push-bump-stir . . . go these toes against your leg for two and one half hours of assorted torture that would make the Medicis turn over in their graves.

But who complains? What are headaches, earaches, backside-aches, poor surroundings, insufficient space, cheap paper, twidgets, mutter-mumblers and kickers compared with the pursuit of higher education? What place does carnal comfort have compared with the nobler thing in life like a.c. circuits or electronics? You are a good student, like the inscription over the entrance to the Ithaca Post Office, "Neither rain, sleet, nor twidgets can deter these reliable workers from their steadfast paths."

You actually work out a problem in an hour. Not an easy problem, but then again, not a hard one. Had you been at home, in the comfort of your own room—even my pasteboard box in the temps is better than those computing rooms. (Please, Mr. Driscoll, give me back my lease, I didn't mean it. Honest, I'll be good . . . I love the little footlocker, I wouldn't live anywhere else)—Had you been in the comfort of your own room you could have done it in ten minutes. But think of the fun you would have missed. For instance, meeting the charming chap who is unable to read the constants, and/or directions written on the blackboard. It isn't a matter of bad eyesight, he can see them all right. It is sort of a paranoid loneliness. His timing, however, is perfect. He waits until you are computing eighteenth roots of twelve on your slide rule, the slider of which has always been too loose, and then, wham! a huge hairy fist grabs your shoulder, shakes you until your teeth rattle and your eyes pop.

You're Wrong!

You look down with tearful eyes at the shattered remains of your slide rule. Well, what more can you lose? You figure, ha, I will get even, ha, I will take revenge. You answer his question. "Ten," you say, chuckling, a last moment of sinister joy. Wham! the same huge hairy fist comes down, grabs you around the neck, and you feel fingers meeting behind your ears. "Ya brainless little punk, I oughta beecher brains out! So many wise guys around here, a guy can't ask a sybil question widout a wise anser."

Now answers are an interesting question. The instructor has the answers. He not only has the answers, but he has the problems all worked out. Sooner or later he will tell everyone the answers. But he doesn't write the answers on the board so that everyone could find them quickly and easily. Like a squirrel protecting a favored acorn from marauding chicken hawks, he creeps around the room, hiding the answers.

You raise your hand and wait to be blessed with a visit. Forty-five minutes later your arm has turned white up to the elbow. Circulation has completely stopped in your hand. Fingers are dropping to the floor. Finally he notices you. Over comes instructor with precious answer sheet. You retrieve your fingers for souvenirs and ask him gently, respectfully, "Uh—ah—er—sir — I mean mr. Uh—Could—Please sir could I see the answer—I mean check my answers with yours?"

"Why of course son," says the great man, "Nothing is too good for a student except instruction. Let's see, problem 21, 21, 21 . . . The answer is . . . "

"Ayeeh!" you scream, "Problem 21? twenty-one? Two One? I've just done problem 12! One two, problem twelve, one two, ack-ack, twidge-twidge, problem 12, ack-ack . . ."

And off you go to the snake pits.

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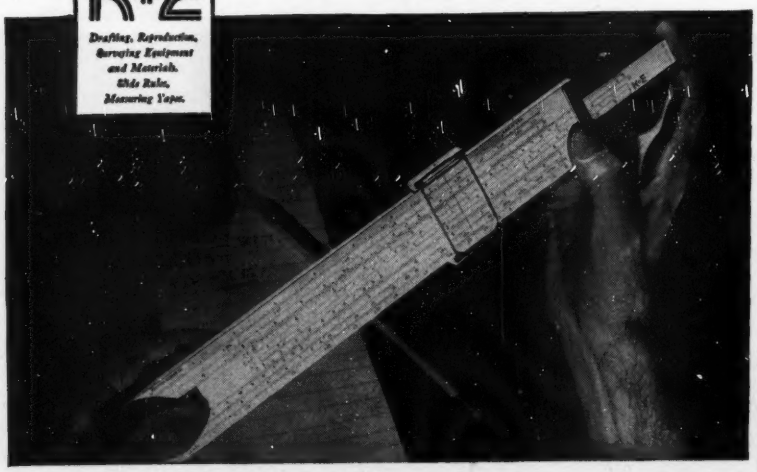

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Throughout the war, Silene EF was used predominantly by the rubber industry and continues to be in increasing demand in this field. However, expanded production is now providing additional volumes of Silene EF for other uses. Thus the product re-enters a highly interesting phase of the work of Columbia's Technical Staff, comprising Research, Development, Technical Service and Market Research, where entirely new applications will be the goal. Pittsburgh Plate Glass Company, Columbia Chemical Division, Fifth at Bellefield, Pittsburgh 13, Pa.

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In a country newspaper appeared the following advertisement:

"The man who picked up my wallet in Fore Street was recognized. He is requested to return it."

The next day this reply was published:

"The recognized man who picked up your wallet requests the loser to call at any time and collect it."

* * *

To women; you are sweet and dear.
God bless you and keep you . . .
Wish I could afford to.

* * *

A man came to a booking agent, and told him: "I have a wonderful act. I have a parrot that sings 'God Bless America' and a dog that plays the piano." The agent was so impressed that he arranged for a tryout. The parrot sang and the dog played. The agent couldn't believe his eyes and said, "This can't be possible." "Well," said the man, "The parrot really doesn't sing. The dog's a ventriloquist!"

* * *

You can lead an engineer to water, but why disappoint him?

* * *

Pvt.: "What's the best way to teach a girl to swim?"

P.F.C.: "That requires technique. First you put your left arm around her waist, then you gently take her left hand and—

Pvt.: "She's my sister."

P.F.C.: "Oh — push her off the dock."

* * *

Student: "I clearly had the right of way when this man ran into me, and yet you say I was to blame."

Local Cop: "You certainly were!"

Student: "Why?"

Local Cop: "Because his father is the mayor, his brother is the chief of police, and I go with his sister."

The members of an exclusive hunt club decided to hold a fox hunt, and instructed the members to bring only male dogs. However, one influential member owned a female, and she was allowed to run with the pack.

The morning of the hunt they followed the dogs for an hour, then lost them completely. One of the hunters saw a farmer in a field and questioned him:

"Have you seen anything of a pack of dogs and a fox?"

"Sure, just a minute ago. They were going that way."

"How were they running?"

"Wal," said the farmer, "the last I saw of them, the fox was running fifth."

* * *

The Dean of the college looked up questioningly at the man who had entered his office, and now stood regarding him gravely. "And what can I do for you, sir?" he inquired.

"I don't suppose you remember me," the visitor began, "I'm Pollard of the class of '30. The year I left school, I was very hard up, and you lent me ten dollars. And I told you that when I made good, I would come back and remind you of it, and pay you back—"

"Go on," said the dean, beaming at him.

"So, here I am. You don't happen to have another ten-spot on you, do you?"

* * *

Father was deep in his easy chair, relaxing after a hard day at the office. Junior, aged five, was bedevilling him with an endless succession of questions.

"Daddy, whatta you do down at the office?" he finally asked.

"Nothing!" shouted daddy.

Junior pondered this extraordinary statement for a moment, and then queried, "But how do you know when you get through?"

They used to have apartments with closets in them. Now they have closets with apartments in them. They have hot and cold elevators, and all night burglar service. Instead of the janitor, the landlord cleans you out. They are ideal for married people, for when a young couple crowds into one of these apartments, there isn't any room for argument.

* * *

Sign on a display of tomatoes in a grocery store: Don't Squeeze Me Till I'm Yours.

* * *

He: 'Why do the most important men on the campus always get the prettiest girls?"

She: "Oh, you conceited thing."

* * *

"That's a very quiet apartment house you live in, isn't it?"

"I'll say! When I rented the apartment the landlord asked if I had any children and I said no." Then he asked, 'Any dogs?' And I said no. Then he wanted to know if I had a canary or other pets and I said, 'No, but I've got a fountain pen that scratches a little'."

* * *

At a fraternity smoker an engineer recently succumbed to a single bottle of beer. He was hit over the head with it.

* * *

A farmer brought some produce to Ithaca and sold it. He thought, "I will surprise my wife." He bought a suit of clothes, a hat, a pair of shoes, and put them under the seat.

On his way home, he stopped at the river, where he took off his old clothes, and threw them in. Then, he looked under the seat, for his new clothes, and found them gone.

Shrugging his shoulders, he got into the buggy and said: "Git up, Maud, we'll surprise her anyway!"